Errata

Title & Document Type: **5326C/27C Frequency Counters Operating and Service Manual**

Manual Part Number: **05326-90038**

Revision Date: **June 1974**

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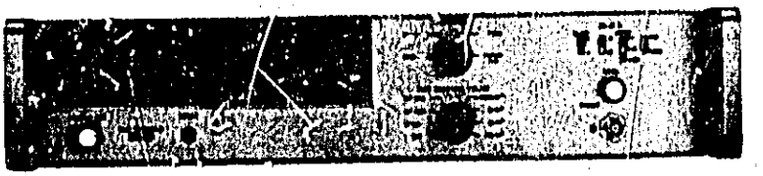
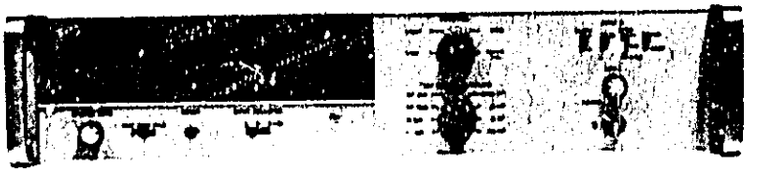
OPERATING AND SERVICE MANUAL

FREQUENCY COUNTERS

5326C/5327C





HEWLETT hp PACKARD

HP 5326C/5327C

CERTIFICATION

The Hewlett-Packard Company certifies that this instrument was thoroughly tested and inspected and found to meet its published specifications when it was shipped from the factory. The Hewlett-Packard Company further certifies that its calibration measurements are traceable to the U.S. National Bureau of Standards to the extent allowed by the Bureau's calibration facilities, or to the calibration facilities of other International Standards Organization members.

WARRANTY AND ASSISTANCE

This Hewlett-Packard product is warranted against defects in materials and workmanship. This warranty applies for one year from the date of delivery. Hewlett-Packard will repair or replace products which prove to be defective during the warranty period provided they are returned to Hewlett-Packard. No other warranty is expressed or implied. We are not liable for consequential damages.

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OPERATING AND SERVICE MANUAL

FREQUENCY COUNTERS
5326C/5327C

SERIAL PREFIXES:

5326C — 1312A
5327C — 1312A

This manual applies to HP Model 5326C and HP Model 5327C having serial prefix number 1312A.

SERIAL PREFIXES NOT LISTED

For serial prefixes above 1312A (5326C and 5327C), a "Manual Changes" sheet is included with this manual. For serial prefixes below 1312A, refer to Section VII of this manual.

5301 STEVENS CREEK BLVD., SANTA CLARA, CALIF. 95050

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TABLE OF CONTENTS

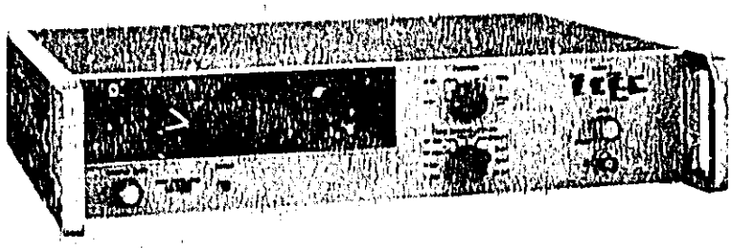
TABLES OF CONTENTS (Continued)

LIST OF TABLES

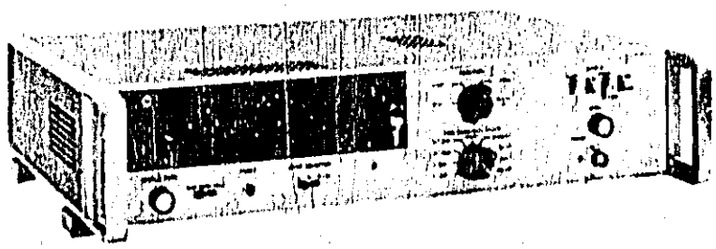
LIST OF FIGURES

Figure 1-1. 5326C/5327C Frequency Counters and Power Cord

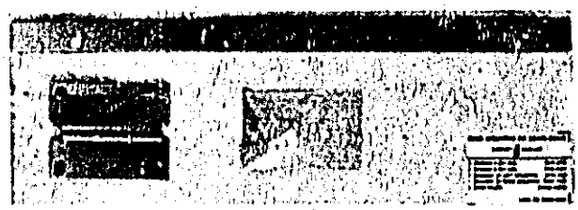
MODEL 5326C



MODEL 5327C



RACK MOUNT KIT



POWER CORD

SECTION I

GENERAL INFORMATION

1-1. DESCRIPTION

1-2. The Hewlett-Packard Models 5326C/5327C Frequency Counters measure frequency, period, period average, ratio, and perform totalizing and scaling functions. The models feature a 7-digit display (8 digits optional), 1 MΩ input impedance, and display storage. Decimal point and unit readouts (annunciators) are displayed automatically with each operating selection. The input channel has an attenuator, trigger slope control, level control, and ac-dc coupling. The basic difference between the two models is the addition of the prescaler assembly in the 5327C. This assembly increases the frequency range from 50 MHz to 550 MHz.

1-3. Electrical and mechanical specifications are listed in Table 1-3.

1-4. IDENTIFICATION

1-5. Hewlett-Packard instruments have a 2-section, 9-digit serial number (0000A00000), located on the rear panel. The 4-digit serial prefix identifies instrument changes. The 5-digit number is the serial number of each instrument. If the serial prefix of your instrument differs from that listed on the title page of this manual, there are differences between this manual and your instrument. Lower serial prefixes are documented in Section VII, and higher serial prefixes are covered with manual change sheets included with the manual. If the change sheet is missing, contact the nearest Hewlett-Packard Sales and Service Office, listed on the inside rear cover of this manual.

1-6. APPLICATIONS

1-7. The 5326C model measures frequency from dc to 50 MHz (5327C to 550 MHz) and period average to 10 MHz. With the FUNCTION switch in the START position, the counter will totalize the number of input pulses. With an external signal applied to OSC jack and the switch set to EXT, the counter will display the ratio between EXT and INPUT A signals, scaled by the time base setting.

1-8. OPTIONS

1-9. Both models can be ordered with the following options: Option 001, 8-digit; Option 002, remote programming; and Option 003, digital recorder output.

1-10. EQUIPMENT SUPPLIED AND ACCESSORIES AVAILABLE

1-11. Table 1-1 lists equipment supplied, and Table 1-2 lists accessories available.

Table 1-1. Equipment Supplied

Description	HP Part No.
Detachable Power Cord, 7-½ feet (229 cm) long	8120-1378
Rack Mounting Kit	05326-60046

Table 1-2. Accessories Available

Description	HP Part No.
Digital Recorder	5055A
Interconnect Cable, Digital Recorder, 6 feet (183 cm)	562A-16C
50-ohm, BNC-to-BNC Coaxial Cable, 4 feet (122 cm)	10503-6001
Circuit Board Extender, 15-pin	5060-0049
Input Amplifier Circuit Board Extender	10532-60001
Circuit Board Extender, 18-pin	5060-2041
Extender Board Kit; includes two 5060-0049, and one each 5060-2041, and 10532-60001	10532A

Table 1-3. Specifications

INPUT CHANNEL A

Range:

dc coupled: 0 — 50 MHz
ac coupled: 20 Hz — 50 MHz

Sensitivity:

0.1 V rms sine wave
0.3 V peak-to-peak pulse
8 ns minimum pulse width
Sensitivity can be decreased by 10 or 100 times, using the ATTEN switch.

Impedance:

1 MΩ shunted by less than 25 pF

Dynamic Input Voltage Range:

0.1 to 3 V rms ac times attenuator setting; ±5 V dc times attenuator setting.

Trigger Level:

PRESET to center triggering about 0 V or variable over the range of -3 V to +3 V times attenuator setting. Trigger threshold band < 1.0 mV, referred to input at maximum frequency.

Overload Protection:

250 V rms on all attenuator settings, except 25 V rms on X1 above 50 kHz.

Slope:

Independent selection of positive or negative slope.

START (Totalizing and Scaling)

Range: 0 — 10 MHz

Factor: 1 — 10^8 in decade steps

Output: Rear Panel TIME BASE BNC

Display: Channel divided by scaling factor

FREQUENCY

Range: 0 — 50 MHz

Input:

Channel A (provides triggered frequency measurement)

Gate Times:

0.1 μs to 10 s in decade steps

Accuracy:

Direct: ±1 count ± time base accuracy

Display:

kHz, MHz, or GHz with positioned decimal point

PERIOD AVERAGE

Range: 0 — 10 MHz

Periods Averaged: 1 — 10^8 in decade steps

Frequency Counted: 10 MHz

Accuracy: ±1 count ± time base accuracy ± trigger error*

Display:

ns, μs with positioned decimal point

RATIO

Display:

Any input function F_{ext} times Multiplier (M)
M=1 to 10^8 selectable in decade steps

Range:

Any input function: See appropriate function section. F_{ext}: (External Oscillator Input) 100 Hz — 10 MHz

Mode:

Any input function

Accuracy:

Accuracy of selected input function ± trigger error of F_{ext}.

*Trigger error is less than +0.3% of one period ÷ periods averaged for signals with 40 dBm or better signal-to-noise ratio and 100 mV rms amplitude.

Table 1-3. Specifications (Continued)

INPUT CHANNEL B (5327C ONLY)

Range:

Direct: 0 to 50 MHz.
Prescaled: 0 to 550 MHz

Sensitivity:

Direct: 15 mV rms.
Prescaled: 25 mV rms.

Impedance: 50Ω nominal.

Maximum Input: 3.5 V rms; 5 V peak.

Trigger Level: 0V

Accuracy:

Direct: ±1 count ± time base accuracy
Prescaled: ±1 count displayed* ± time base accuracy

Display:

MHz, kHz, or GHz with positioned decimal point

GENERAL SPECIFICATIONS

Display: 7 digits (8 optional)

Blanking:

Suppresses display of unwanted zeros left of the most significant digit.

Display Storage:

Holds reading between samples. Rear panel switch overrides storage.

Sample Rate:

FAST position: Continuously variable from less than 100 μs to approximately 20 ms.
NORM position: Continuously variable from less than 20 ms to approximately 5 seconds.
HOLD position: Display can be held indefinitely.

Overflow:

Neon indicates when display range is exceeded.

Operating Temperature: 0° to 50° C

*±10 counts of input frequency (±1 count displayed)

TIME BASE

Crystal Frequency: 10 MHz

Stability:

Aging Rate: <3 parts in 10^7/mo.
Temperature: ≤±2.5 parts in 10^6, 0° to 50°C.
Line Voltage: ≤±1 part in 10^7 for 10% line voltage.

Oscillator Output:

10 MHz, TTL type output levels, 50Ω series impedance at rear panel BNC.

External Input:

100 Hz — 10 MHz; 1 V rms into 1 kΩ.

Time Base Output:

Negative pulses, +3 V to 0 V (open circuit), typically 100 ns wide. In START output is INPUT A frequency divided by TIME BASE/ MULTIPLIER switch setting. Available at rear panel BNC.

Gate Output:

TTL level pulses; low while gate open, high while gate closed. Available at rear panel BNC.

Weight:

5326C: Net, 15 lb, 3 oz. (6, 9 kg).
Shipping 18 lb, 1 oz. (8, 5 kg).

5327C: Net, 15 lb, 7 oz. (7, 0 kg).
Shipping, 18 lb, 5 oz. (8, 3 kg).

Dimensions:

3-25/32" high by 16-¾" wide by 11-¼" long (88 by 425 by 286 mm).

Equipment Supplied:

Power cord (7-½ ft.) and rack mounting kit

Accessories Available:

HP 10503A, 50Ω BNC Cable, 4 Ft. (122 cm).
HP 10532A, Extender Board Kit containing
2 ea. 15-pin extender 5060-0049,
1 ea. 18-pin extender 5060-2041, and
1 ea. Amplifier Extender, 10532-60001.

HP Cable 562A-16C (6 ft, 183 cm) to connect 5326C with Option 003 to HP 5050B or 5055A Digital Recorder.

Option 001: 8-digit display

Option: 002: Remote programming

Table 1-3. Specifications (Continued)

Controls: All front panel controls are single line programmable except:

NORM-CHK
FAST/NORM Mode
Input Attenuators
AC/DC Input Signal Coupling

Control Signal: Single line control using either contact closure to ground, DTL or TTL drive on all lines except trigger level which is analog programmed (+3 to -3 Vdc).

Connector: Rear panel connector: HP 1251-0085; Amphenol 57-40360-375. (36-pin blue ribbon)

Mating Connector: HP 1251-0084; Amphenol 57-30360-375.

Options 003: Digital output (for numerals only)

Code: 4-line 1-2-4-8 BCD, "1" state high "0" state +0.25V at -1 mA; "1" state: +5V open circuit, 2.5 kΩ source impedance nominal.

Print Command: +5 V to 0 Vdc coupled; occurs at end of gate.

Storage: Buffer storage is provided so BCD output is constant while next measurement is being made.

Inhibit Input: Inhibits gate when instrument's cycle time is less than the time required for external equipment to interrogate BCD output. Positive inhibit +5 Vdc.

Connector: Rear panel connector: HP 1251-0087; Amphenol 57-40500-375. (50-pin blue ribbon).

Mating Connector: HP 1251-0086; Amphenol 57-30500-375.

Option 010: Oscillator Assembly.

Crystal Frequency: 10 MHz
Type: TCXO
Aging Rate: $<1 \times 10^{-7}$/mo.
Temp. Stability: $<\pm 5 \times 10^{-7}$, 0° to 50°C.
Short Term Fluctuation: $<1 \times 10^{-9}$ rms* (1 sec. avg.).

Warm-up: (room temp crystal).

Line Voltage: $<\pm 5 \times 10^{-8}$ (10% change).

Option 011: Oscillator Assembly.

Crystal Frequency: 10 MHz.
Type: Oven-controlled oscillator
Aging Rate: $<5 \times 10^{-10}$/day.
Temp. Stability: $<3 \times 10^{-9}$, 0° to 50°C.
Short Term Fluctuation: $<1 \times 10^{-11}$ rms (1 sec avg.).

Warm-up: $<\pm 5 \times 10^{-9}$ in 15 min.
Line Voltage: $<5 \times 10^{-9}$ (10% change).

*Typical

SECTION II
INSTALLATION

2-1. INTRODUCTION

2-2. This section contains information for unpacking, inspection, repacking, storage, and installation. The instructions for remote programming are also given in this section.

2-3. UNPACKING AND INSPECTION

2-4. If the shipping carton is damaged, ask that the carrier's agent be present when the instrument is unpacked. Inspect the instrument for damage (scratches, dents, broken knobs, etc.). If the instrument is damaged or fails to self-check (Self-Check Procedures, Figure 3-3), notify the carrier and the nearest Hewlett-Packard Sales and Service Office immediately (offices are listed at the back of this manual). Retain the shipping carton and padding material for the carrier's inspection. The sales and service office will arrange for the repair or replacement of your instrument without waiting for the claim against the carrier to be settled.

2-5. STORAGE AND SHIPMENT

2-6. Packaging

2-7. To protect valuable electronic equipment during storage or shipment always use the best packaging methods available. Your Hewlett-Packard Sales and Service Office can provide packing material such as that used for original factory packaging. Contract packaging companies in many cities can provide dependable custom packaging on short notice. Here are two recommended packaging methods:

a. RUBBERIZED HAIR. Cover painted surfaces of instrument with protective wrapping paper. Pack instrument securely in strong corrugated container (350 lb/sq. in. bursting test) with 2-inch rubberized hair pads placed along all surfaces of the instrument. Insert fillers between pads and container to ensure a snug fit.

b. EXCELSIOR. Cover painted surfaces of instrument with protective wrapping paper. Pack instrument in strong corrugated container (350 lb./sq. in. bursting test) with a layer of excelsior about 6 inches thick packed firmly against all surfaces of the instrument.

2-8. Environment

2-9. Conditions during storage and shipment should normally be limited as follows:

a. Maximum altitude: 25,000 feet.
b. Minimum temperature: -40°F (-40°C).
c. Maximum temperature: +167°F (+75°C).

2-10. RACK INSTALLATION

2-11. The counter is ready for bench operation as shipped from the factory. Additional parts necessary for rack mounting are packaged with the instrument. To convert to rack installation, proceed as follows:

a. Remove tilt stand.

b. Remove feet (press the foot-release button, slide foot toward center of instrument, and lift off).

c. Remove adhesive-backed trim strips at front end of sides.

d. Attach filler strip along bottom edge of front panel, using two screws on outer edges of filler strip. Omit the center screw.

e. Attach flanges to front end of sides (larger corner notch toward bottom of instrument). Instrument is now ready to mount in standard rack.

CAUTION

Ambient temperature in rack during operation should not exceed 122°F (50°C). Be sure instrument position in the rack permits adequate air circulation and that nearby equipment does not discharge hot air directly on the instrument.

2-12. POWER CONNECTION

2-13. Line Voltage

2-14. The counter may be operated from either 115 or 230 volt (±10%) power lines. A slide switch on the rear panel permits quick conversion for operation from either voltage. Insert a narrow-blade screwdriver in the switch slot and slide the

switch to the right for 230 volt operation ("230" marking exposed) or to the left for 115 volt operation ("115" marking exposed). The counter is supplied with a 115 volt fuse; be sure to replace this fuse for 230 volt operation (see Table 2-1).

CAUTION

Before plugging instrument into ac power line be sure LINE VOLTAGE switch is properly positioned.

Table 2-1. 115/230 Volt Conversion

Line Voltage Conversion	115 Volt	230 Volt
Slide Switch	Left (115)	Right (230)
AC Line Fuse	1.5 Ampere Slow-Blow (HP 2110-0304)	.8 Ampere Slow-Blow (HP 2110-0020)

2-15. Power Cable

2-16. The counter is equipped with a detachable 3-wire power cable. Proceed as follows for installation.

a. Connect plug (3-socket connector) to ac line jack at rear of instrument.

b. Connect plug (2-blade with round grounding pin) to 3-wire (grounded) power outlet. Exposed portions of instrument are grounded through the round pin on the plug for safety; when only 2-blade outlet is available, use connector adapter (HP part No. 1251-0048), then connect short wire from side of adapter to ground.

2-17. REMOTE PROGRAMMING

2-18. The following paragraphs describe remote programming requirements for the counter.

2-19. Front-Panel Controls

2-20. The following front-panel controls are programmable:

a. FUNCTION
b. TIME BASE/MULTIPLIER
c. LEVEL control
d. SAMPLE RATE and HOLD
e. SLOPE
f. RESET
g. INPUT SELECTOR (5327C only)

2-21. The following front-panel controls are NOT programmable:

a. AC/DC
b. FAST/NORM
c. ATTEN
d. CHK

2-22. The trigger LEVEL control may be remotely programmed, or the front-panel LEVEL control may be used manually. When remote programming is used, the LEVEL control must be set to PRESET. Display time may be remotely programmed and/or the front-panel control may be used.

2-23. Remote Programming Requirements

2-24. All lines may be controlled by TTL or DTL signals or contact closure to ground J10(36), with the exception of the trig level (J10 pin 30), which is programmed by an analog level, and the sample rate hold (J10 pin 35). The sample rate hold line should NOT be pulled up to +5 V by less then 200Ω while programming. In order to remote program the counter, the following must be done:

a. Set FUNCTION switch to any function except START or STOP.

b. Ground the EXT line at J10 pin 17. Ground is available at J10(36).

c. Select the desired FUNCTION (see paragraph 2-29).

d. Select the desired TIME BASE (see paragraph 2-31).

e. In addition to these, the following may be done:

Select the slope (+ or -) for the input channel by grounding the slope line for negative (-) and leaving it open for positive (+). This is done on J10 pin 28.

2-25. Trigger Level Programming

2-26. Before programming the trigger LEVEL control, place the knob in the PRESET position. Select the trigger level by putting a dc voltage that is between -3.0 and +3.0 volts onto the trigger level line at J10 pin 30. This voltage, times the attenuator, is the trigger level. Preset is programmed by leaving the pin open or grounded (grounding is preferable if noise exists on the remote program lines). The AC/DC and ATTEN switches on the front panel must be set manually, as they are not programmable.

2-27. Adjusting the Display Time (Sample Rate Knob, Plus FAST/NORM Switch).

2-28. Adjusting the display time, when remote programming, is accomplished by using one of the following methods:

a. Manually adjust the display time by using the front-panel controls, (SAMPLE RATE/FAST-NORM).

b. Set the SAMPLE RATE control full cw and the FAST/NORM/HOLD switch in NORM and connect a 1 MΩ variable resistor in series with 1 kΩ from +5 V to pin 35. This will give a display-time range of about 10 ms to 5 seconds. If a shorter time is desired, move the FAST-NORM-HOLD switch to FAST, which then gives a range of about 50 μs to 10 ms.

c. Set the SAMPLE RATE control full ccw, place FAST/NORM/HOLD switch in the FAST position, and hold the SAMPLE RATE HOLD line (J10 pine 35) to ground for the desired display time. The display continues for about 100 μs after the ground is released.

2-29. The sample rate disable line is used only with the start command to initiate a totalizing measurement. The sample rate disable command disables auto reset and enables continuous plus and minus transfer commands.

2-30. The computer inhibit command (when Low) inhibits the main gate from opening. This command may be sent from a computer to prevent the counter from making any further measurements. It may also be used as an external sample rate signal, since the command would determine the time between measurements. Auto reset and print command signals are not disabled by computer inhibit.

NOTE

DO NOT ground or otherwise program any of the remote programming lines if the unit is not being operated remotely (EXT line HIGH = not programmed remotely). The line should be left open or, at worst, be pulled up to +5 V by a source impedance of not less than 5 kΩ.

2-31. Function Selection Programming

2-32. To program the desired function, ground (<.7 volt) the proper line at J10 as follows:

STOP	Pin 32
START	Pin 1, 32
PERIOD AVERAGE	Pin 2
FREQ	Pin 6
ENABLE A*	Pin 8
ENABLE B*	Pin 9
ENABLE B+10*	Pin 18

NOTE

When switching between START and STOP, doe not remove the ground from Pin 32.

2-33. Time Base Selection Programming

2-34. To program the Time Base, ground (<.7 volt) the proper line at J10:

.1 μs/1	Pin 19
1 μs/10	Pin 20
10 μs/10^2	Pin 21
.1 ms/10^3	Pin 22
1 ms/10^4	Pin 23
10 ms/10^5	Pin 24
.1 s/10^6	Pin 25
1 s/10^7	Pin 26
10 s/10^8	Pin 27

2-35. BLANKING DEFEAT

2-36. This counter is designed to blank insignificant zeros (zeros to left of data). When blanking occurs, the digital recorder output for the blanked columns is BCD 15 (HHHH). To use this instrument with a digital-analog converter, it is necessary to defeat the blanking feature by repositioning the two jumpers on the A9 Display board. Move the jumpers to position 2, as shown in A9 Component Locator (Section VIII). This connects pin 10 of A9U7 and A9U8 to +5 V. Also, lift the pin 1 lead of A8U2 and connect pin 1 to ground (available at U2 pin 7).

*5327C Model only. Must also select function.

SECTION III

OPERATION

3-1. INTRODUCTION

3-2. Section III contains the operating information that is needed to obtain the most effective performance from the instruments. This includes a general description of the operating modes, the function of all controls and indicators, a self-check procedure, and setup procedures for making basic measurements.

3-3. OPERATING MODES

3-4. The following paragraphs describe the operating modes of totalize, frequency, period average, and ratio.

3-5. Totalize Mode

3-6. START and STOP positions on the FUNCTION selector allow manual opening and closing of the counter's main gate. When the switch is in the START position, the counter does not measure frequency, but instead, counts the number of times the signal passes through the trigger point. The input signal, connected to the front-panel INPUT A or B jack, is divided by the MULTIPLIER switch setting prior to counting. For example, when the MULTIPLIER switch is set to the 1 position, every pulse is counted. When the switch is set to 10^3, the counter registers every one-thousandth pulse. When the FUNCTION switch is set to STOP, the counter stops totalizing and holds the displayed count until the RESET switch is pressed or the MULTIPLIER switch setting is changed. If the FUNCTION switch is again set to START before a reset is generated, the count continues to totalize from the previous displayed value. With the FUNCTION switch set to START, the scaled input signal is available at the rear-panel TIME BASE OUTPUT jack. The unit indicators and decimal points are blanked during the totalize mode. The C light is on (in START), indicating counting is taking place.

3-7. Frequency Mode

3-8. In the frequency mode, the input signal connects to the front-panel jack and can be conditioned with the LEVEL, SLOPE, and ATTEN controls. Each cycle of the input signal produces an internal pulse; these pulses are counted while the main gate is open. The gate time is determined by the setting of the TIME BASE switch. The longer the gate is open, the better the resolution and accuracy.

Example: Measure 1 MHz with gate times of 0.1 ms and 10 ms.

1 MHz = 1×10^6 pulses/second

SIGNAL	TIME BASE SWITCH	DISPLAY
1×10^6 p/s	$\times 0.1 \times 10^{-3}$ sec =	1.00 MHz
1×10^6 p/s	$\times 10 \times 10^{-3}$ sec =	1000.0 kHz

3-9. Period Average Mode

3-10. The period average mode allows multiple period averages to be made with input frequencies of up to 10 MHz. This mode is useful for making low frequency measurements where maximum resolution is desired. For example, if 10^2 period averaging is selected, the counter will display the average of 100 periods of the input frequency with the proper decimal point. The accuracy for period average is:

$$\pm \text{time base} \pm \frac{\text{Trigger error} \pm 1 \text{ count}}{\text{number of periods averaged}}$$

For single period measurements, set MULTIPLIER switch to the 1 position.

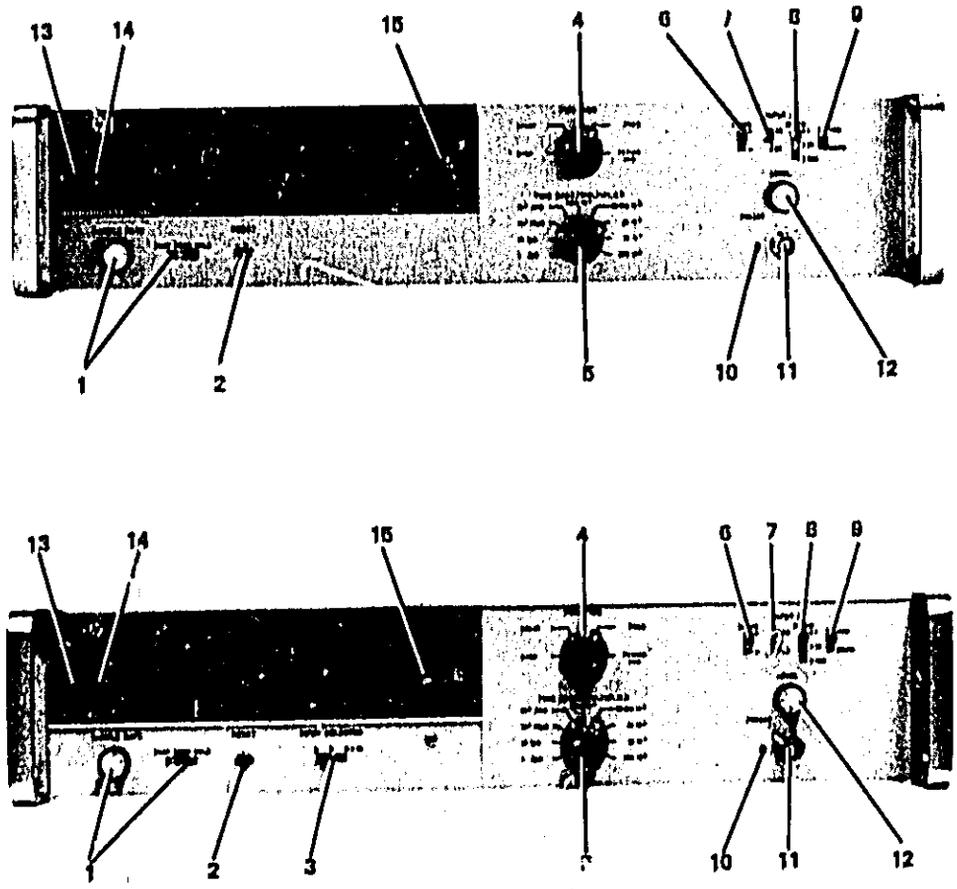
3-11. Ratio

3-12. The counter may be used to measure the ratio of two signals in either the frequency or period-average mode. By setting the rear-panel OSC INT-EXT switch to EXT, the counter will accept an external signal (F_{ext}) for use as the internal oscillator. This frequency should be 100 Hz to 10 MHz at 1 V rms minimum to 5 V peak maximum. A second signal (F_A), applied to either INPUT A or B jack, is used as the comparator signal. The MULTIPLIER switch controls the resolution of the display. For a ratio of frequencies, the Ratio = $\frac{F_A}{F_{ext}} = \frac{\text{DISPLAYED NUMBER}}{\text{MULTIPLIER SETTING}}$ For a ratio of periods (P), the Ratio =

$$\frac{P_A}{P_{ext}} = \frac{F_{ext}}{F_A} = \frac{\text{DISPLAYED NUMBER}}{\text{MULTIPLIER SETTING.}}$$

3-13. Disregard the units and decimal point; also, ignore any zeros to the left of the most significant digit. It makes no difference which signal is higher in frequency, as long as the two frequencies are within the specifications of their respective channels.

Figure 3-1. Front Panel Controls and Indicators



1. SAMPLE RATE control. Applies primary power. Works in conjunction with FAST-NORM-HOLD slide switch to control interval between measurements.

   a. FAST — Varies display time from <100 µs to >20 ms. STORAGE switch (rear panel) must be ON to use this mode.

   b. NORM — Varies display time from <20 ms to >5 seconds.

   c. HOLD — Holds display indefinitely.

2. RESET pushbutton. Resets display and internal count to zero and starts new measurement.

3. INPUT SELECTOR switch (5327C). Selects the desired input channel and counting method, direct or prescaled.

   a. A — Counter measures signal applied to INPUT A.

   b. B — Counter directly measures signal applied to INPUT B (rear panel). Channel is dc coupled to accept dc to 50 MHz at 15 mV rms (min).

   c. B÷10 — Counter prescales signal applied to INPUT B (rear panel). Channel is dc coupled to accept 0-550 MHz at 25 mV rms (min).

Figure 3-1. Front Panel Controls and Indicators (Continued)

4. FUNCTION selector. Selects mode of operation. Blue lettering matches corresponding blue lettering on TIME BASE/MULTIPLIER switch. Select channel with INPUT SELECTOR switch (5327C).

   a. STOP, START — Used during totalize mode to manually open and close counter's main gate and to turn scaled output on and off. Usable with any input channel.

   b. PERIOD AVG — Sets counter to measure period of signal applied to any input channel. Use MULTIPLIER switch to select number of periods to be averaged.

   c. FREQ — Sets counter to measure frequency applied to any input channel. Selecting gate time with TIME BASE switch determines resolution.

5. TIME BASE/MULTIPLIER switch. Works with the FUNCTION switch; and for each mode, it performs as follows:

   a. Totalize — Determines scaling factor for input signal prior to counting.

   b. Frequency — Opens the main gate for the selected amount of time.

   c. Period Average — Used to select the number of periods to be averaged.

6. SLOPE slide switch. Permits triggering on positive or negative slope of input signal.

7. AC-DC slide switch. Used to select direct or capacitor coupling for input signal. Minimum input frequency on AC setting is 20 Hz.

8. ATTEN (attenuator) slide switch. Used to select attenuation for input signal. Used in conjunction with LEVEL control to set input triggering point. Maximum input; 250 V rms on all ranges except 25 V rms on X1 range above 50 kHz. Recommended input is 0.1 V rms to 2 V rms times attenuator setting.

9. CHK-NORM (check-normal) switch

   a. CHK — substitutes internal 10 MHz oscillator signal for INPUT A signal.

   b. NORM — counter performs measurements in normal manner.

10. Trigger Lamp. Lamp lights when input signal passes through amplifier trigger level.

11. INPUT A jack. Accepts signal for all measurements when INPUT SELECTOR switch is set to A position. Input impedance is 1 MΩ shunted by less than 25 pF, 10 MΩ when using ten-to-one divider probe.

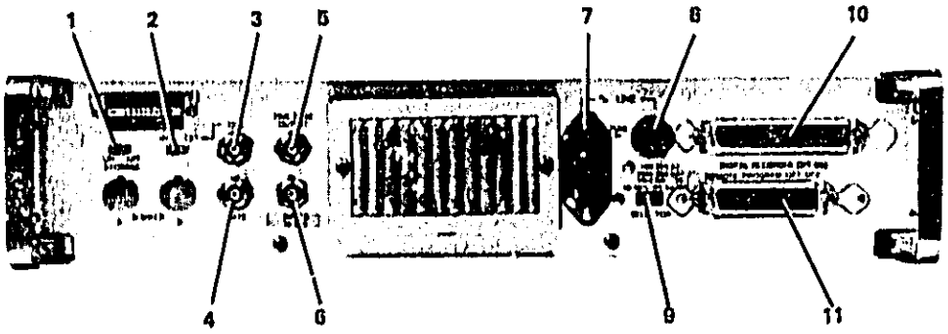
12. LEVEL control. Used with ATTEN switch to determine trigger level. With X1 attenuator setting, level is variable ±3 volts, on X10, ±30 volts; and on X100, ±300 volts.

13. C (count) Annunciator light. Lights when counter's main gate is open. For short-duration gate times, the annunciator circuits include a 50 ms one-shot MV to allow a visible flash to the C light.

14. OF (overflow) Annunciator light. Lights when accumulated count exceeds counter capacity.

15. * (asterisk) light. Indicates that proper units are not displayed with combination of function/time base selection. To interpret display, add a zero to right of least significant digit displayed on counter.

Figure 3-2. Rear Panel Controls and Connectors



1. STORAGE switch. When set to ON, counter displays previous measurement while new measurement is being made. In OFF position, allows continuous display of data being fed into decade dividers.

2. OSC switch. In INT position, counter operates in normal manner, using internal 10 MHz oscillator for the time base. In EXT position, permits use of external time base for increased stability, normalizing, or ratio measurements.

3. OSC jack. With INT-EXT switch set to INT, provides 10 MHz, >3 volt peak-to-peak output (no load), 50-ohm series impedance. With INT-EXT switch set to EXT, allows external time base input of 100 Hz to 10 MHz at 1 volt rms (5 V peak maximum).

4. GATE OUTPUT jack. Provides >2.4 volts output (no load) for external use (50Ω series resistance). Output is low (0 to 0.4 V) when counter's main gate is open.

5. TIME BASE OUTPUT jack. Provides negative going >+3 V to 0 V pulses (open circuit), >50 nanoseconds wide. In totalize, output is the input frequency divided by MULTIPLIER setting.

6. INPUT B jack (5327C). Works with INPUT SELECTOR switch to measure signal directly or by prescaling. Trigger level is zero volts, and the signal is not conditioned by the LEVEL, SLOPE, or ATTEN controls.

7. AC LINE jack. IEC type with offset pin connected to chassis.

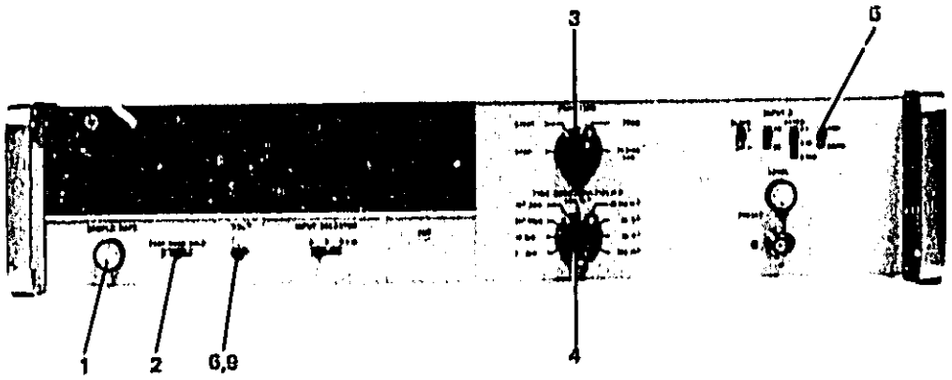
8. AC LINE fuse. 1.5 Ampere slow-blow fuse for 115 V, 0.8 Ampere slow-blow fuse for 230 V operation.

9. 115/230 volt switch. Insert narrow screwdriver and slide the switch to show desired voltage.

10. DIGITAL RECORDER connector (Option 003 only). 50-pin connector for digital recorder interconnection.

11. REMOTE PROGRAM connector (Option 002 only). 36-pin connector to allow remote control of counter modes and functions.

Figure 3-3. Self-Check (for 5326C and 5327C)



1. Set SAMPLE RATE control slightly clockwise out of OFF.
2. Set FAST-NORM-HOLD switch to NORM.
3. Set FUNCTION switch to STOP.
4. Set MULTIPLIER selector to 1.
5. Set CHK-NORM switch to CHK.
6. Press RESET button and check that counter's right-hand column displays a 0 and all other digits are blanked.
7. Set FUNCTION switch to START and check that counter totalizes and the C light is on. Check that OF light goes on as display overflows.
8. Set FUNCTION switch to STOP. Check that the C light goes out and display is held.
9. Push RESET button. Display should be zero.
10. Set FUNCTION switch to PERIOD AVG. Set MULTIPLIER switch (4) as shown in table below, and check for proper display.

Part of Figure 3-3. Self-Check (For 5326C/5327C) (Continued)

MULTIPLIER	DISPLAY (± 1 Count)			ANNUNCIATOR		
	5326/27C	5327C		5326/27C	5327C	
	A	B	B÷10	A	B	B÷10
1	.1	.0	.00	µs	µs	µs
10	.10	.00	.000	µs	µs	µs
10^2	.100	.000	.0000	µs	µs	µs
10^3	100.0	.0	.00	ns	ns	ns
10^4	100.00	.00	.000	ns	ns	ns
10^5	100.000	.000	.0000	ns	ns	ns
10^6	100.0000	.0000	.00000	ns	ns	ns
10^7 Standard	00.00000	.00000	.000000	ns OF	ns	ns
10^7 Option 001	100.00000			ns		
10^8 Standard	0.000000	.000000	.0000	ns OF[1]	ns	*
10^8 Option 001	00.000000			ns OF[1]		

[1]Wait 10 seconds

11. Set FUNCTION switch to FREQ, set TIME BASE as shown in Table below and check for proper display.

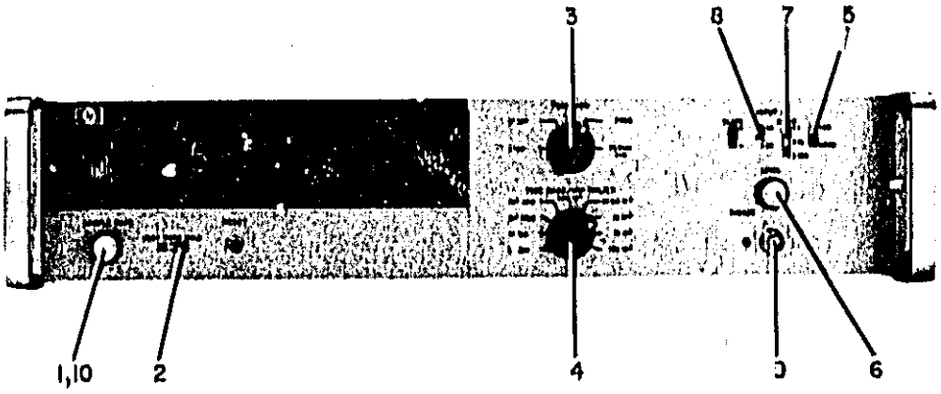
TIME BASE	DISPLAY (± 1 Count)			ANNUNCIATOR		
	5326/27C	5327C		5326/27C	5327C	
	A	B	B÷10	A	B	B÷10
.1 s	.01	.00	.0	GHz	GHz	GHz
1 s	10	0	.00	MHz	MHz	GHz
10 s	10.0	.0	0	MHz	MHz	MHz
.1 ms	10.00	.00	.0	MHz	MHz	MHz
1 ms	10.000	.000	.00	MHz	MHz	MHz
10 ms	10000.0	.0	0	kHz	kHz	kHz
1 s	10000.00	.00	.0	kHz	kHz	kHz
1 s Standard	0000.000	.000	.00	kHz OF	kHz	Khz
1 s Option 001	10000.000	.000	.00	kHz	kHz	kHz
10 s Standard	000.0000	.0000	.000	kHz OF[1]	kHz	kHz
10 s Option 001	0000.0000	.0000	.000	kHz OF[1]	kHz	kHz

[1]Wait 10 seconds.

NOTE

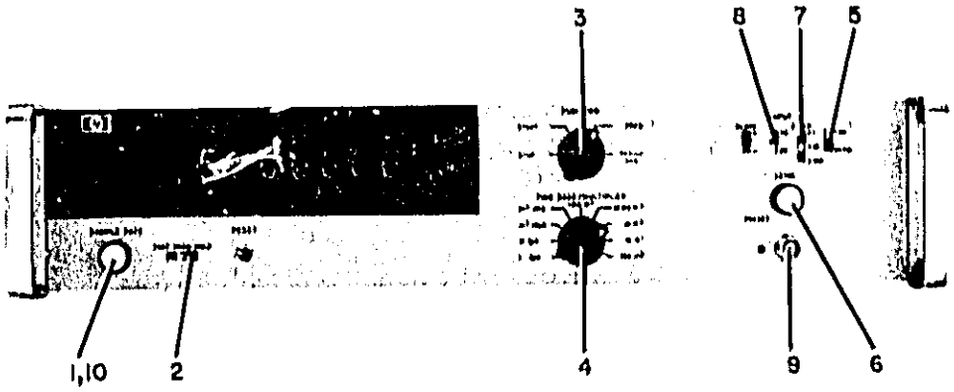
Push RESET after changing positions of INPUT SELECTOR switch.

Figure 3-4. Frequency Measurements



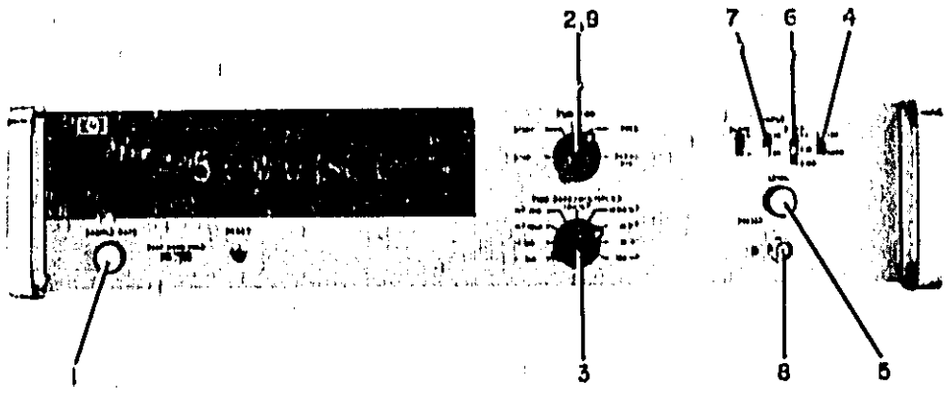
1. Set SAMPLE RATE control slightly clockwise out of OFF.
2. Set FAST-NORM-HOLD switch to NORM.
3. Set FUNCTION switch to FREQ.
4. Set TIME BASE switch for desired gate time.
5. Set CHK-NORM switch to NORM.
6. Set LEVEL control to PRESET for triggering at zero volts or to desired trigger level.
7. Set ATTEN switch to match input signal amplitude.
8. Set AC-DC switch to AC or DC.
9. Connect input signal (0 to 50 MHz) to INPUT A jack.
10. Adjust SAMPLE RATE control for convenient measurement interval. SAMPLE RATE and FAST/NORM control the delay between measurements.

Figure 3-5. Period Average Measurements



1. Set SAMPLE RATE control slightly clockwise out of OFF.
2. Set FAST-NORM-HOLD switch to NORM.
3. Set FUNCTION switch to PERIOD AVG.
4. Set MULTIPLIER to number of periods to be averaged.
5. Set CHK-NORM switch to NORM.
6. Set LEVEL control to PRESET for triggering at zero volts or to desired trigger level.
7. Set ATTEN switch to match input signal amplitude.
8. Set AC-DC switch to AC or DC.
9. Connect input signal (0 to 10 MHz) to INPUT A jack.
10. Adjust SAMPLE RATE control for convenient measurement interval.

Figure 3-6. Totalizing Measurements

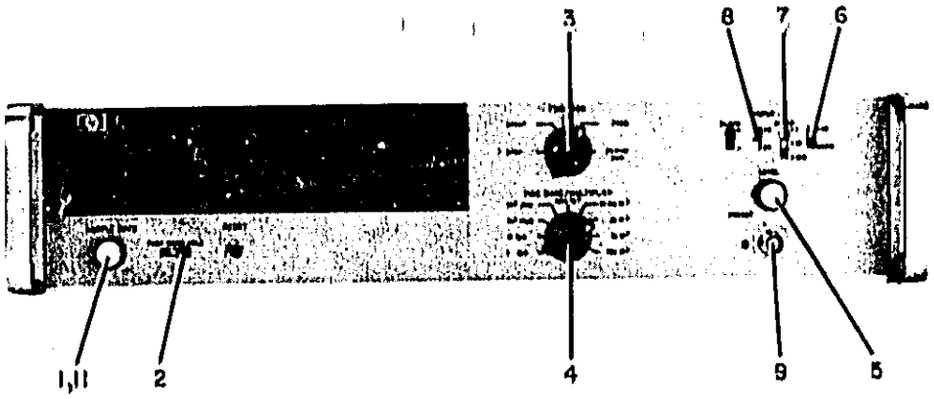


1. Set SAMPLE RATE control slightly clockwise out of OFF. SAMPLE RATE does not work in totalize, since the input signal controls the display time.
2. Set FUNCTION switch to STOP.
3. Set MULTIPLIER switch to input signal scaling factor. Input signal is divided by setting of switch.
4. Set CHK-NORM switch to NORM.
5. Set LEVEL control to desired trigger level or to PRESET for triggering at zero volts.
6. Set ATTEN switch to match input signal amplitude.
7. Set AC-DC switch as needed.
8. Connect input signal (0 to 10 MHz) to INPUT A jack.
9. Set FUNCTION switch to START. The displayed value will accumulate at a rate determined by the input signal divided by the MULTIPLIER switch setting.

NOTE

Input signal divided by MULTIPLIER switch setting is available at the rear-panel TIME BASE OUTPUT jack.

Figure 3-7. Ratio Measurements

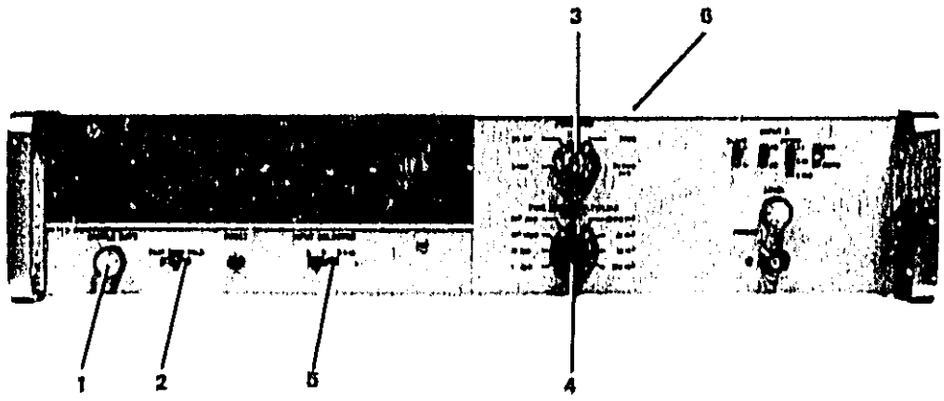


1. Set SAMPLE RATE control slightly clockwise out of OFF.
2. Set FAST-NORM-HOLD switch to NORM.
3. Set FUNCTION switch to FREQ or PERIOD AVG.
4. Set MULTIPLIER switch to desired dividing factor.
5. Set INPUT A LEVEL control to desired trigger level or to PRESET for triggering at zero volts.
6. Set CHK-NORM switch to NORM.
7. Set ATTEN switch to match input amplitude.
8. Set AC-DC switch as needed.
9. Connect F_A (0 to 50 MHz) to INPUT A jack.
10. Set OSC INT-EXT switch (rear-panel) to EXT. Connect F_{ext} to OSC jack F_{ext} can be 100 Hz to 10 MHz at 1 V rms (min) to 5 V peak maximum.
11. Adjust SAMPLE RATE control for convenient measurement interval.
12. Ratio = $\frac{F_A}{F_{ext}} = \frac{\text{Display}}{\text{MULTIPLIER}}$ for frequency measurements or

    Ratio = $\frac{P_A}{P_{ext}} = \frac{F_{ext}}{F_A} = \frac{\text{Display}}{\text{MULTIPLIER}}$ for the period average mode.

    Disregard units and decimal point.

Figure 3-8. Input B Measurements



(5327C only)

1. Set SAMPLE RATE control slightly clockwise out of OFF.

2. Set FAST-NORM-HOLD switch to NORM.

3. Set FUNCTION switch to FREQ or PERIOD AVG.

4. Set TIME BASE/MULTIPLIER switch for desired resolution.

5. Set INPUT SELECTOR switch to B for direct counting or B+10 for prescaling by 10 of the input signal.

6. Connect input signal to INPUT B jack (rear panel). Input signal is dc to 50 MHz at 15 mV to 3.5 V rms for B position and 0 to 550 MHz at 25 mV to 3.5 V rms for B+10 position. Maximum input frequency for PERIOD AVG B+10 measurement is 100 MHz. Maximum input frequency for PERIOD AVG B measurement is 10 MHz.

SECTION IV

THEORY OF OPERATION

4-1. INTRODUCTION

4-2. This section discusses the general operating principles of the instrument. Assembly description is covered in more detail in Section VIII, opposite each schematic diagram. Logic fundamentals are explained in Paragraph 4-3 through 4-16.

4-3. LOGIC SYMBOLS

4-4. Two states exist in the binary system, 1 and 0. In positive logic, the 1 state is more positive than the 0 state. High (H) and Low (L) are used to represent the 1 and 0 levels. *HIGH ALWAYS REPRESENTS THE MORE POSITIVE LEVEL, WHETHER IT BE POSITIVE OR NEGATIVE LOGIC.*

4-5. A circle at the input line of a logic symbol indicates that a low activates the function. Figure 4-1B shows that a low at both inputs produces a high output. A circle at the output line of a logic symbol indicates a low when activated, as shown in Figure 4-1C.

4-6. Gating and Logic

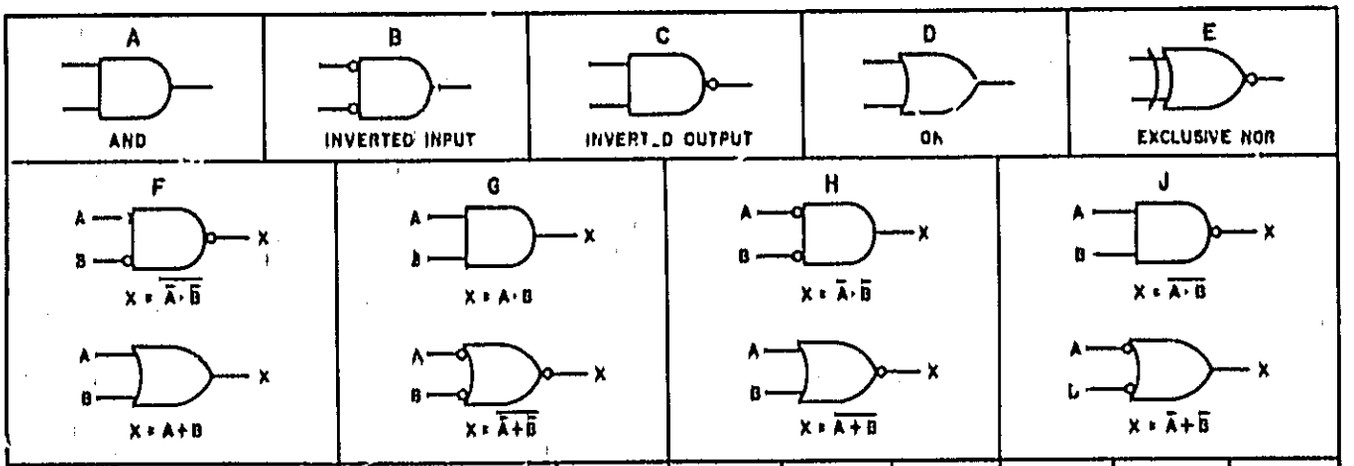
4-7. Figure 4-1A represents a basic AND gate. The output is high if all inputs are high. An AND gate may have two or more inputs. Figure 4-1D represents a basic OR gate. The OR gate output is high if one or more of its inputs is high. An OR gate may have two or more inputs. An OR gate with a circle on the output is called a NOR gate. An AND gate with a circle on the output is called A NAND gate. An EXCLUSIVE NOR (Figure 4-1E) has two inputs; and the output will be low if one, but not both, of the inputs is high. The output will be high if the inputs are both low or both high.

4-8. INTEGRATED CIRCUIT OPERATION

4-9. JK Master-Slave Flip-Flop

4-10. The JK master-slave flip-flop is basically a bistable multivibrator. With simultaneous high inputs to J and K, before the clock pulse, Q and $\bar{Q}$ will change states after the clock pulse. Refer to Figure 4-2 and Table 4-1. This circuit triggers on the trailing edge (negative transition) of the clock pulse. The set (S) and reset (R) inputs operate as follows: when a low is applied to set input, $\bar{Q}$ goes low and Q goes high; when a low is applied to reset input Q goes low and $\bar{Q}$ goes high. Set or reset can override all other inputs at any time.

Figure 4-1. Gate Symbols and Logic Comparisons



A	B	X	A	B	X	A	B	X	A	B	X
H	H	H	H	H	H	H	H	L	H	H	L
H	L	H	H	L	L	H	L	L	H	L	H
L	H	H	L	H	L	L	H	L	L	H	H
L	L	L	L	L	L	L	L	H	L	L	H

Figure 4-2. JK Flip-Flop

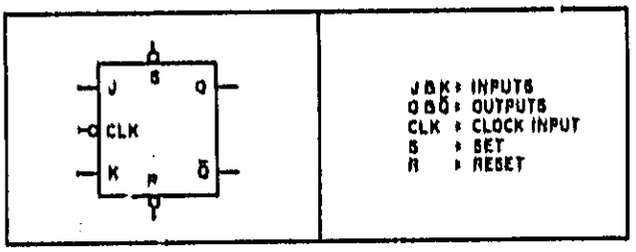


Table 4-1. Truth Table

t_n		$t_n + 1$		t_n = Before clock pulse
J	K	Q	$\overline{Q}$	TN + 1 = After clock pulse
L	L	Q_n	$\overline{Q}_n$	If J = L and K = L, then Q and $\overline{Q}$ will not change from what they were before the clock pulse.
H	L	H	H	If J = H and K = L, then Q will be H and $\overline{Q}$ will be L after the clock pulse.
L	H	L	H	If J = L and K = H, then Q will be L and $\overline{Q}$ will be H after a clock pulse.
H	H	Q_n	$\overline{Q}_n$	If J = H and K = H before the clock pulse, then after the clock pulse Q and $\overline{Q}$ will change states.

4-11. Time-Base Decade

4-12. In the reset state, Carry Output (CO) (see Figure 4-3) is high and, if the Gate input (G) is low, Gated Output (GO) is low. Ten pulses on the Gate input produce a negative transition at the Gated Output. If the G input is high, GO is open-circuited, regardless of the count. The Carry Output gives a positive transition after 10 pulses.

4-13. Open-Collector Gate

4-14. The output of an open-collector gate can be paralleled with gates of the same type to perform a wire-OR function, as shown in Figure 4-4. When the outputs are tied to the same line, any one of the gates can pull the line low without damaging itself.

Figure 4-3. Time-Base Decade 1820-0412

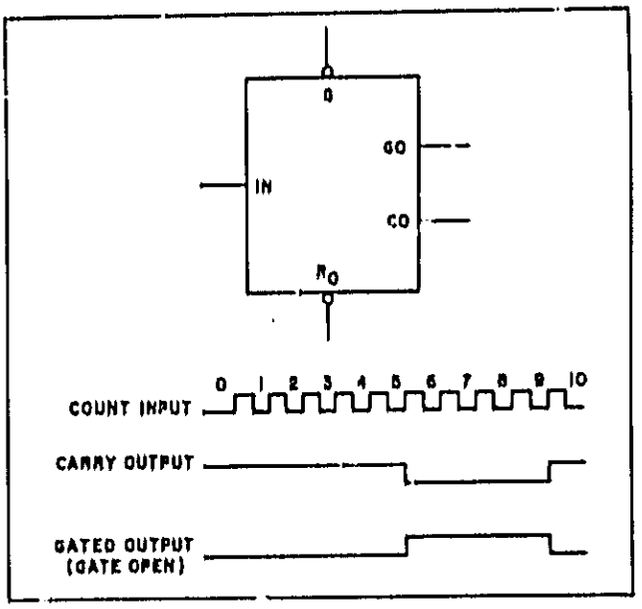
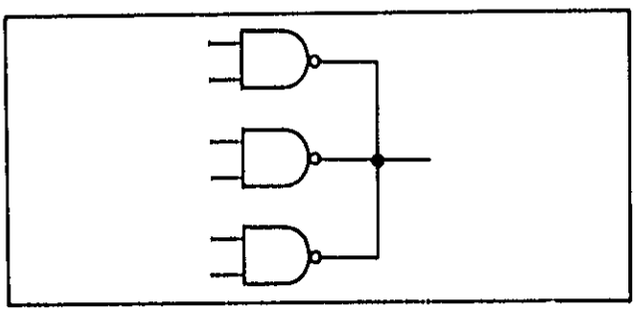


Figure 4-4. Open-Collector Gate 1820-0327



4-15. Logic Levels

4-16. This counter uses three types of logic: TTL (transistor-transistor logic), ECL (emitter-coupled logic), and DTL (diode-transistor logic). See Table 4-2 for specific logic levels.

Table 4-2. Logic Levels

Type	H (Min)	L (Max)	Trigger	Supply
ECL	-.7 V	-1.4 V	-1.2 V	-5.0 V
TTL	2.4 V	0.4 V	1.5 V	5.0 V
DTL	2.6 V	0.4 V	1.5 V	5.0 V

4-17. OVERALL COUNTER OPERATION

4-18. The signal connected to INPUT A is conditioned by the front-panel switches of the Attenuator Assembly. These switches set the operating conditions for trigger level, coupling, and the required slope. The Input Amplifier converts the signal

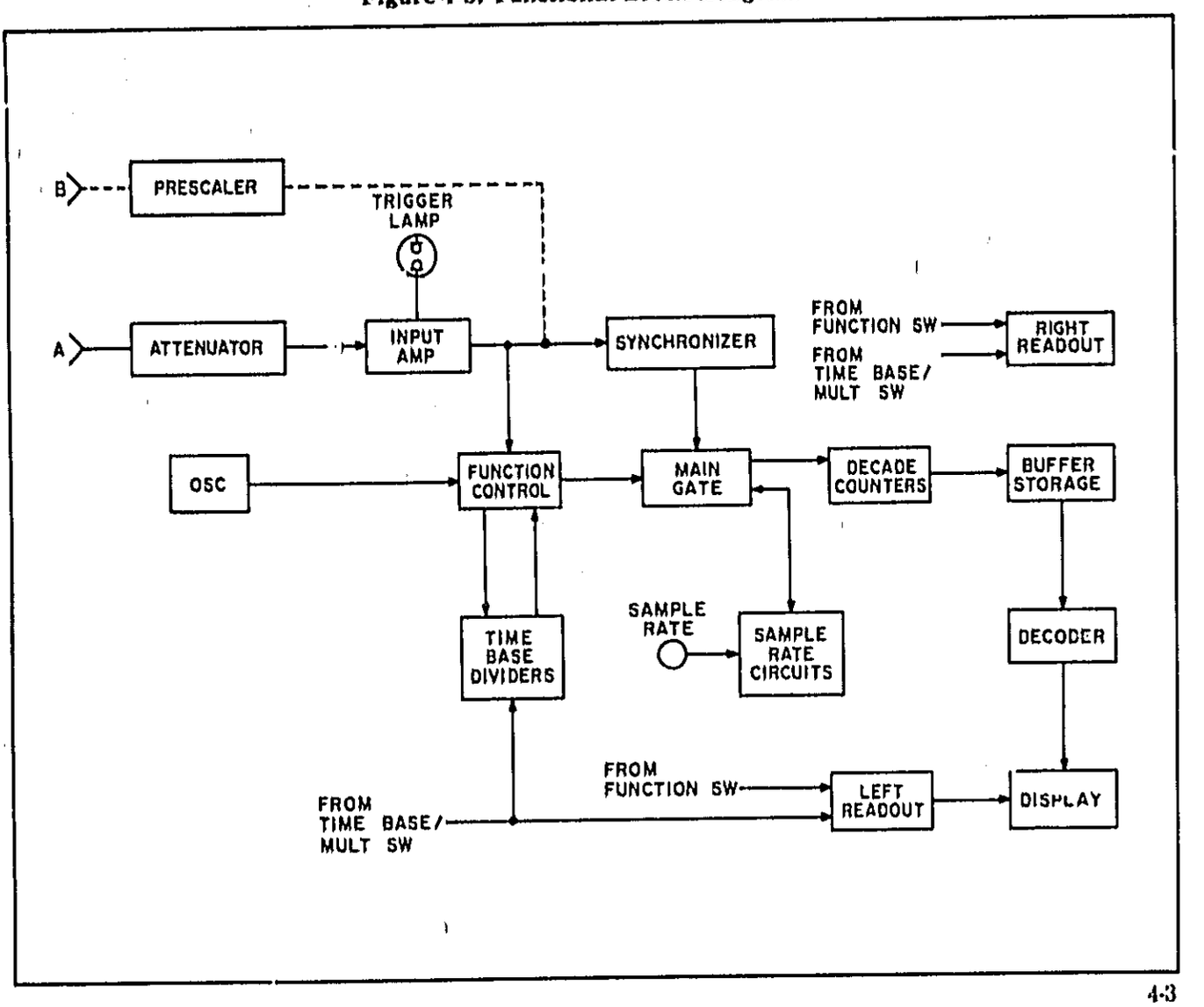
into narrow pulses for more efficient usage throughout the counter (Figure 4-5). In the 5327C, INPUT B provides an alternate path through the Prescaler Assembly, which divides the signal by 10 or passes it directly to the Function Control. The path taken is determined by the setting of the front panel INPUT SELECTOR switch.

4-19. The Function Control accepts both the input signal and the 10 MHz internal oscillator pulses and routes them in accordance with the mode of operation being used. One of these signals is sent to the Time Base Assembly, which divides the signal as determined by the front panel TIME BASE/ MULTIPLIER switch. The first and last pulse of the divided signal controls the length of time the main gate is open. During this time, the other signal is sent directly to the main gate for totalizing in the decade counters and is subsequently displayed. The synchronizer prevents the main gate from opening unless an input signal is present.

4-20. The sample rate circuits control the interval between measurements. When the main gate closes, these circuits provide a delay, as controlled by the front panel SAMPLE RATE controls. When the sample rate period has elapsed, a reset pulse is generated to reset the counter and start a new measurement.

4-21. The signal to be counted, either the internal oscillator or input signal, passes through the main gate to the decade counters. The buffer storage registers store the BCD count before it is translated into a decimal equivalent and displayed on the front panel. Also displayed on the front panel are the units of measurement and the decimal point. The left and right readout assemblies contain the unit indicators and the logic necessary to position the decimal point.

Figure 4-5. Functional Block Diagram



4-22. Frequency Mode

4-23. Frequency is defined as the number of periodic events per unit of time. The counter, therefore, measures an unknown signal (COUNT) for a known length of time (Figure 4-6). The 10 MHz internal oscillator provides the known time and controls the opening of the main gate. The Time Base Assembly divides the oscillator frequency by powers of 10 to open the main gate from 10^{-7} seconds to 10 seconds. The longer the gate is open, the more pulses of the unknown frequency are counted and, therefore, the better the resolution and accuracy.

4-24. Period Average Mode

4-25. The MULTIPLIER switch selects the number of periods to be averaged (Figure 4-7). The Time Base Assembly counts the number of periods selected with the switch and holds the main gate open until this count is complete. The Decade Counter totalizes the oscillator pulses while the main gate is open.

4-26. Totalize Mode

4-27. The main gate can be manually held open with the front-panel START/STOP positions of the FUNCTION switch. With the switch in the START position (Figure 4-8), the counter totalizes the number of times the signal passes through the trigger point. In the case of a typical frequency measurement, this would be a totalizing of the periods. Before the signal is counted, it is divided in the Time Base Assembly by the setting of the MULTIPLIER switch.

4-28. Instrument Timing

4-29. In addition to the timing diagrams relating directly to the individual measurements, Figure 4-9 shows other counter pulses necessary for operation.

Figure 4-6. Frequency Measurement Mode

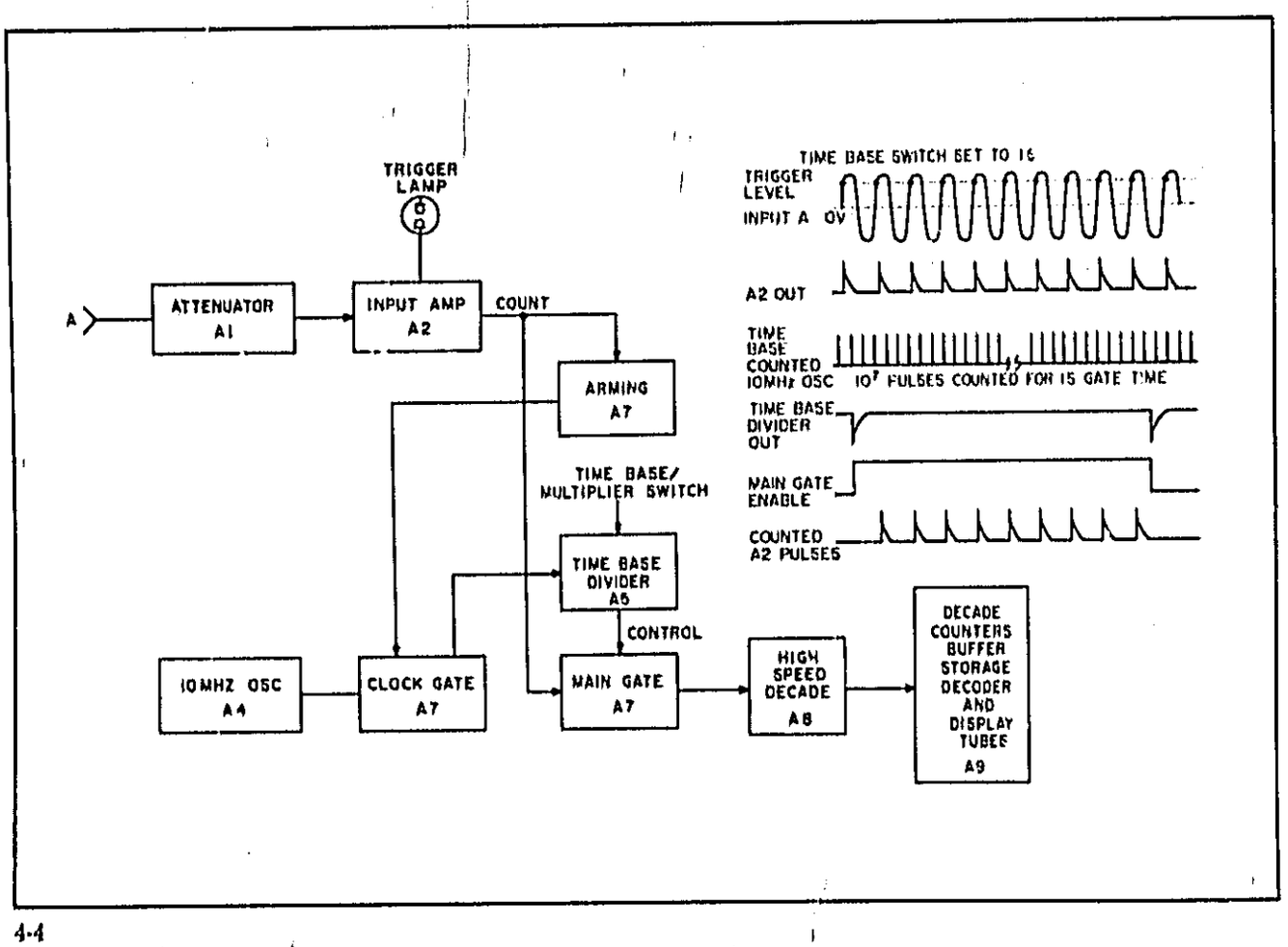


Figure 4-7. Period Average Measurement Mode

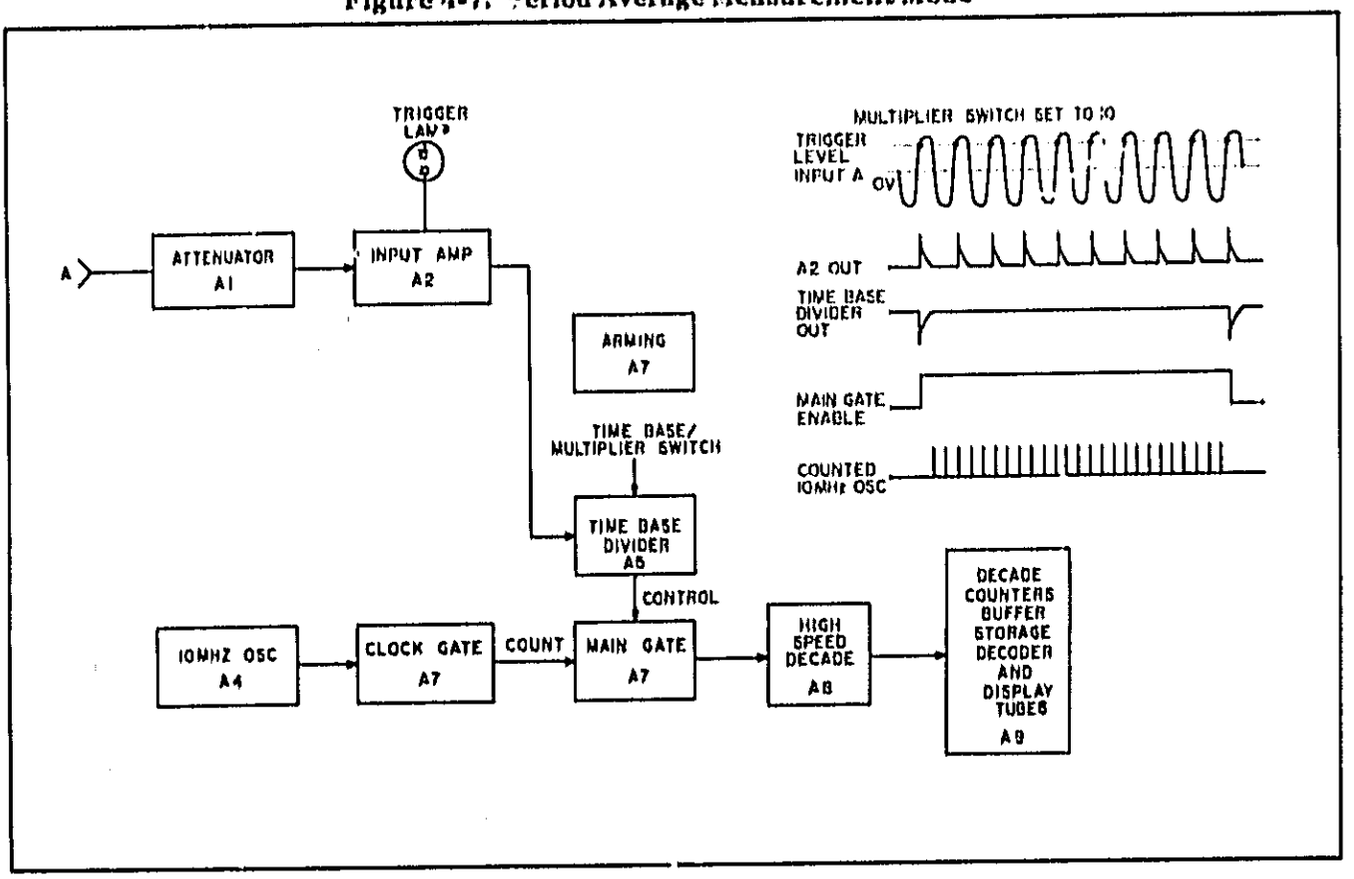


Figure 4-8. Totalize Measurement Mode

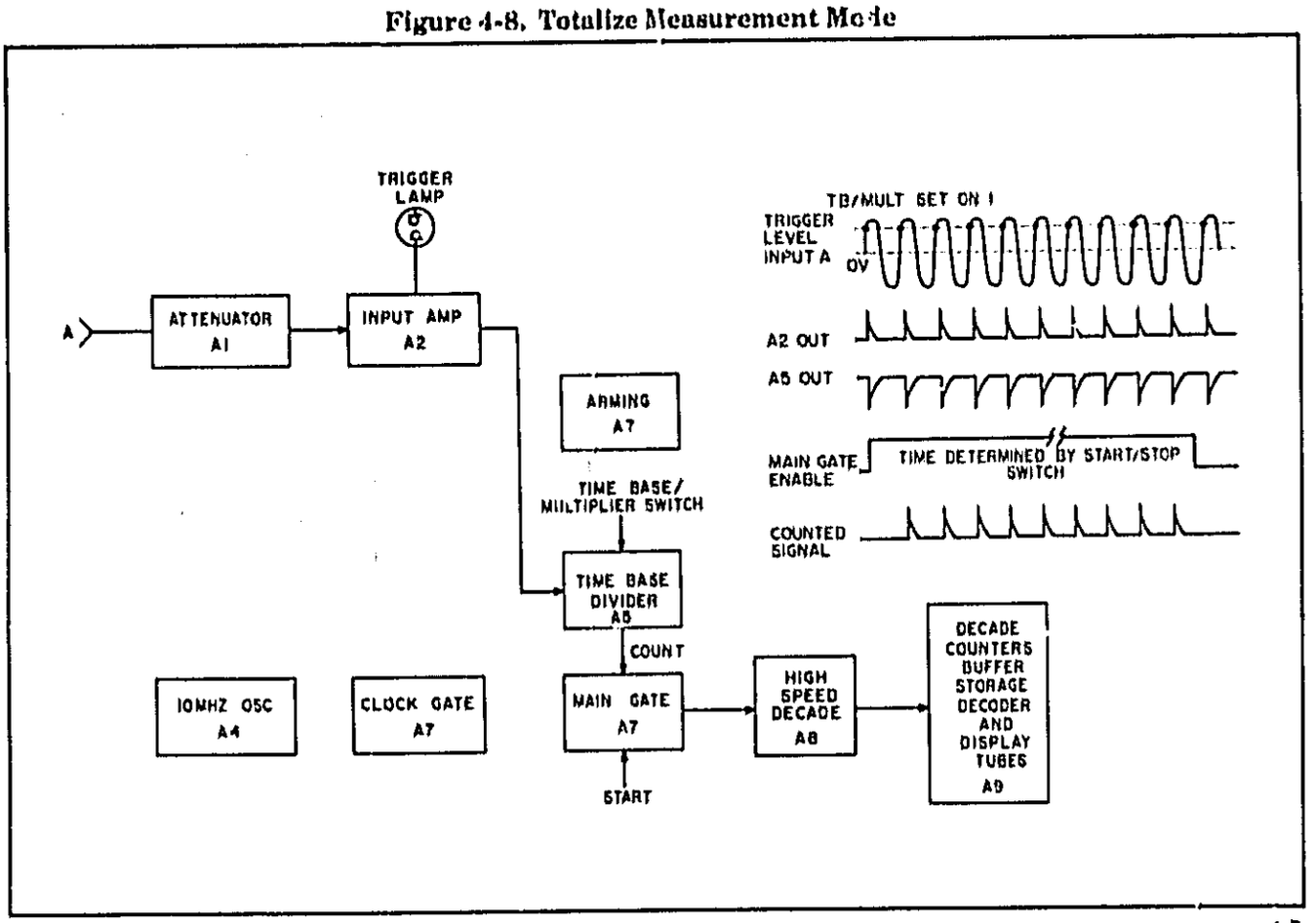
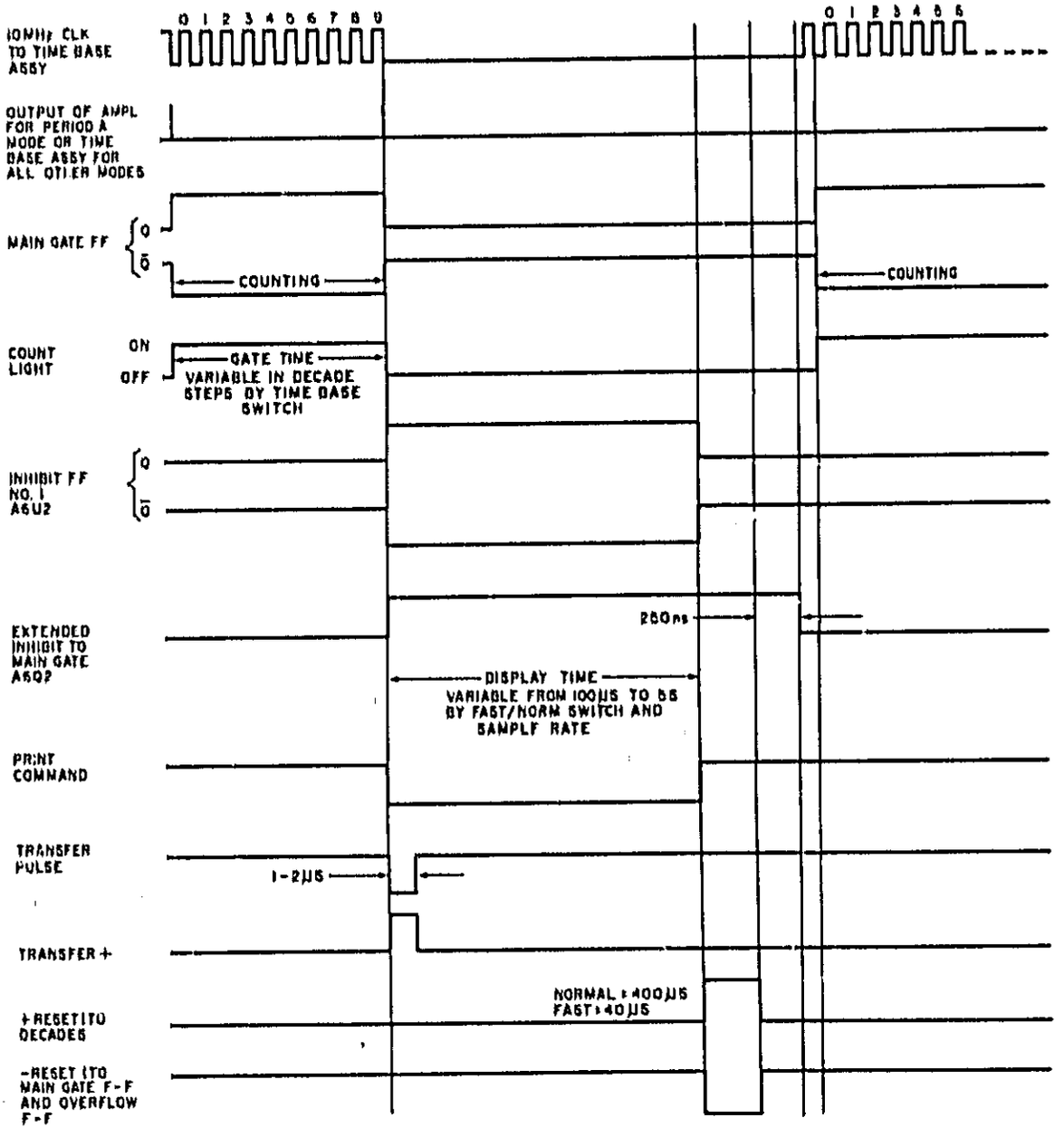


Figure 4-9. Instrument Timing Diagram



SECTION V

MAINTENANCE

5-1. INTRODUCTION

5-2. This section gives maintenance and service information. Included is a table of typical problems for trouble isolation, recommended test equipment, in-cabinet performance checks, which may be used to verify proper counter operation, and adjustment procedures.

5-3. ASSEMBLY DESIGNATIONS

5-4. Table 5-1 lists the designation, name, and Hewlett-Packard part number of assemblies used in this instrument.

Table 5-1. Assembly Identification

ASSY	NAME	HP PART NO.
A1	Attenuator	05326-60048
A2	Input Amplifier	05326-60004
A3	Not Assigned	
A4	Oscillator	05326-60002
A5	Time Base Control	05326-60005
A6	Sample Rate	05326-60013
A7	Function Control	05326-60045
A8	Display Support	05326-60009
A9	Display	05326-60008
A9	Display (Option 001)	05326-60025
A10	Right Readout	05326-60036
A11	Left Readout	05326-60035
A12	Not Assigned	
A13	Not Assigned	
A14	Not Assigned	
A15	Regulator	05327-60020
A16	Interconnect	05327-60028
A17	Not Assigned	
A18	Prescaler (5327C)	05327-60053

5-5. TEST EQUIPMENT

5-6. Test equipment recommended for maintaining and checking performance is listed in Table 5-2. Test equipment having equivalent characteristics may be substituted for the equipment listed.

Table 5-2. Recommended Test Equipment

Instrument Type	Required Characteristics	Recommended Type
Frequency Standard	1 MHz output	HP 107A
Oscilloscope	50 MHz Bandwith	HP 180A
Vertical Plug-in	50 mV/cm Sensitivity	HP 1801A
Time Base Plug-in	50 MHz Bandwidth	HP 1820A
Test Oscillator (2 required)	10 Hz to 10 MHz at 5 volts p-p	HP 651B
Audio Oscillator	2 Hz to 100 kHz 100 mV rms	HP 202C
HF Signal Generator	50 kHz to 50 MHz at 3 volts rms	HP 606B
VHF Signal Generator	10 to 480 MHz	HP 608F
Frequency Doubler	240 - 550 MHz	HP 10515A
Pulse Generator	10 MHz rep-rate 8 nsec pulse width, 0.3 volts p-p output	HP 216A
Electronic Counter	.1 Hz to 10 MHz Frequency Measurements	HP 5245L
Variable Line Transformer	103 to 127 volts rms and 206 to 254 volts rms	Superior Electronic Power Stat 3PF116 (115 V); 3PF 216 (230 V)
Digital Recorder	Print Rate: 10 lines/sec, Data Input: +8421 BCD parallel entry, accepts 1 = +5 V, 0 = +0.25 V. Accepts negative going +5 to 0V print command	HP 5055A
DC Voltmeter	0 to 200 Vdc, 1% Accuracy	HP 412A
AC VTVM	0 to 250 Vac	HP 400F
RF Voltmeter	1 mV to 3 V	HP 3406A

5-7. IN-CABINET PERFORMANCE CHECK

5-8. GENERAL. The performance check, Table 5-3, and test card can be used to verify proper operation of all circuits in the counter and may also be used as follows:

a. As part of an incoming inspection check of instrument specifications.

b. Periodically, for instruments used in systems where maximum reliability is important.

c. As part of a procedure to locate defective circuits.

d. After any repair or adjustment and before returning instrument to regular service.

e. As a permanent record of instrument maintenance performed, because the test record page is perforated and may be removed.

5-9. VARIABLE LINE VOLTAGE. During the test (Table 5-3), the counter should be connected to a variable voltage source, so the line voltage may be varied ±10% from nominal (115 or 230 Vac).

5-10. TROUBLE ISOLATION

5-11. The trouble isolation table (Table 5-5) lists the common problems a counter might develop. Before beginning the overall troubleshooting, a quick check of the power supply voltages and the oscillator signal may save time. These test points are available on the main interconnect board — remove bottom cover.

5-12. The table is divided into three sections, under the headings of count problems, display problems, and input problems. The following is an explanation of table usage with problem 2 of "Input Problems" as the example. The Symptom column identifies the specific counter problem, while the initial conditions column calls out the counter's switch settings or specifies a mode or modes of operation. The test point column asks that A2P1(C) be checked (Test 1) for an ECL High. Do not proceed to Test 2 until the check is evaluated. If A2P1(C) is High (Test is Positive), perform Test Point 2. If A2P1(C) is Low (Test is Negative), the problem can be either a or b; check in order listed.

5-13. REPAIR

5-14. Printed Circuit Component Replacement

5-15. Component-lead holes in the circuit boards have plated walls to ensure good electrical contact between conductors on opposite sides of the board. To prevent damage to this plating and the replacement component, apply heat sparingly, and work carefully. The following replacement procedure is recommended:

a. Remove defective component.

b. Melt solder in component-lead holes. Use clean dry soldering iron to remove excess solder. Clean holes with a wooden toothpick or splinter. Do not use metal tool for cleaning as this may damage through-hole plating.

c. Bend leads of replacement component to the correct shape and insert into component-lead holes. Using heat and solder sparingly, solder leads in place. Heat may be applied to either side of the board, but do not apply excess pressure with soldering iron.

d. Through-hole plating breaks are indicated by separation of the round conductor pad from either side of the board. To repair breaks, press conductor pad against board and solder replacement component lead to conductor pad on both sides of board.

5-16. Replacing Integrated Circuits

5-17. Following are two recommended methods of replacing integrated circuits:

a. SOLDER GOBBLER. This is the best method. Solder is removed from the board by a hollow tip soldering iron connected to a vacuum source. The IC is removed intact, so it may be re-installed if found to be operative.

b. CLIP OUT. This method should be used as a last resort only. Clip the leads as close to the case as possible. With a soldering iron and long-nose pliers, carefully remove the wires from each hole. Clean holes as described in Paragraph 5-15b.

Table 5-3. In-Cabinet Performance Check

1. TIME BASE STABILITY AND OUTPUT

a. Set Counter controls as follows:

SAMPLE RATE	Mid-position
FAST/NORM/HOLD	NORM
FUNCTION	FREQ
TIME BASE/MULTIPLIER	10 s
SLOPE	+
AC/DC	DC
ATTEN	X1
CHK-NORM	NORM
LEVEL	PRESET
STORAGE	ON
OSC	INT

NOTE

Allow 1-hour warm-up before proceeding to Step b.

b. Connect 1 MHz frequency standard to INPUT A.

c. A counter display of 000.0000 (1000.0000 Option 001) indicates that counter time-base frequency is exactly 10 MHz. The offset between counter time base and 1 MHz frequency standard can be determined by subtracting 10 MHz from the indicated oscillator frequency.

COUNTER DISPLAY	A4 OSCILLATOR FREQUENCY
999.9950 kHz	10 000 050 Hz
999.9960 kHz	10 000 040 Hz
999.9970 kHz	10 000 030 Hz
999.9980 kHz	10 000 020 Hz
999.9990 kHz	10 000 010 Hz
1 000.0000 kHz	10 000 000 Hz
1 000.0010 kHz	9 999 990 Hz
1 000.0020 kHz	9 999 980 Hz
1 000.0030 kHz	9 999 970 Hz
1 000.0040 kHz	9 999 960 Hz
1 000.0050 kHz	9 999 950 Hz

d. Record frequency offset on test card. For long-term stability, operate the counter continuously for at least 1-month. Measure frequency offset at 1-month intervals.

e. To calibrate the counter's time base to the frequency standard, perform time-base adjustment in Table 5-4.

NOTE

Temperature must be held constant or compensation for temperature difference must be made whenever a frequency difference is recorded. Unless a record of the temperature and date of last calibration is available, the frequency offset should not be considered drift or aging rate of the 10 MHz crystal.

Table 5-3. In-Cabinet Performance Check (Continued)

f. To check time-base stability vs. line voltage variations, connect variable transformer to counter power cord. Vary line voltage ±10% and record frequency difference on test card. Should be ≤1 part in 10^7.

g. To check time-base stability vs. temperature, vary counter operating temperature between 0°C and 50°C. Record frequency on test card. Should be ≤2.5 parts in 10^6.

h. Connect oscilloscope vertical input to OSC jack on counter's rear panel. Use 10:1 probe at OSC jack to reduce load.

i. Oscilloscope should display 10 MHz waveform nominal at >2.4 volts peak-to-peak amplitude. Record on test card.

2. DISPLAY, DECIMAL POINTS, AND DIVIDERS

Proper operation is verified in the Self-Check procedures in Figure 3-3. Record on test card.

3. FREQUENCY RESPONSE AND SENSITIVITY

a. Set counter controls as in 1a, except TIME BASE to 1s and AC/DC switch to AC.

b. Connect a BNC T connector to INPUT A jack. Connect sine wave test oscillator output to T connector. Connect oscilloscope's vertical input to T connector to monitor input signal amplitude; use a 50-ohm feedthrough at oscilloscope BNC.

c. Adjust test oscillator from 20 Hz to 50 MHz, maintaining 100 mV rms input amplitude. Counter should properly display all frequencies in this range. Record on test card.

d. Set audio oscillator frequency to 2 Hz. Counter should not count. Switch AC/DC switch to DC. Counter should count input signal.

e. Connect a cable (using a clip-lead) to A16P1A(8) and connect other end to Z axis of oscilloscope.

f. Adjust test oscillator output for 1,000 Hz at 8 volts peak-to-peak.

g. Set LEVEL to PRESET and check that oscilloscope marker is at 0 volts.

h. Set SLOPE to +. Vary LEVEL control and check that marker is variable over at least -3.0 to +3.0 volts on the positive slope of waveform.

i. Set SLOPE to -. Vary LEVEL control and check that marker is variable over at least -3.0 to +3.0 volts on the negative slope of waveform. Record on test card.

4. PULSE OPERATION

a. Set counter controls as follows:

FUNCTION	FREQ
TIME BASE	0.1 s
SLOPE	+
AC/DC	AC
ATTEN	X1
LEVEL	PRESET
CHK-NORM	NORM
STORAGE	ON
OSC	INT

Table 5-3. In-Cabinet Performance Check (Continued)

b. Connect BNC T connector to INPUT A. Connect pulse generator to T. Connect oscilloscope to T connector, using 50-ohm feedthrough at the oscilloscope BNC.

c. Adjust pulse generator output for 10 MHz repetition rate, 15 ns pulse width at 0.3 volts peak-to-peak indication on oscilloscope.

d. Check that counter displays the repetition rate, count light flashes, and trigger lamp is on. Record on test card.

e. Repeat above check for 10 kHz. Record on test card.

5. PERIOD AVERAGE

a. Set counter controls as in step 1a with FUNCTION to PERIOD AVG and MULTIPLIER to 1.

b. Connect test oscillator to INPUT A, using BNC T. Connect oscilloscope to T, using 50-ohm feedthrough at oscilloscope BNC.

c. Set test oscillator to 2 Hz at 100 mV rms. Counter should display the period of the input signal (approximately 0.5 sec.). Record on test card.

d. Vary test oscillator frequency from 2 Hz to 10 MHz, maintaining 100 mV rms input amplitude. Change MULTIPLIER switch as needed to maintain meaningful display with change of frequency. Counter should properly display the period of the frequencies in this range within accuracy specifications of the instrument. Record on test card.

6. TOTALIZE

a. Set counter controls as follows:

FUNCTION ..... START
MULTIPLIER 1
CHK-NORM ..... CHK

b. Check that display totalizes, count light (C) is on, and trigger lamp lights. Record on test card.

c. Using 10:1 divider probe, connect oscilloscope vertical input to TIME BASE OUTPUT jack on counter rear panel.

d. Check that oscilloscope indicates 10 MHz negative going pulses at least 3 volts peak-to-peak, typically >30 nsec wide at 50% points. Set MULTIPLIER to 10 and observe output pulses typically 100 ns wide. The frequency output is 1 MHz.

e. Disconnect oscilloscope from TIME BASE OUTPUT jack and connect TIME BASE OUTPUT to 5245L Electronic Counter input. Set 5245L for frequency measurements.

Table 5-3. In-Cabinet Performance Check (Continued)

f. Set TIME BASE/MULTIPLIER as follows and check for proper counter display. Record on test card.

TIME BASE/MULTIPLIER	5245 DISPLAY
1	10 MHz
10	1 MHz
10^2	100 kHz
10^3	10 kHz
10^4	1 kHz
10^5	100 Hz
10^6	10 Hz
10^7	1 Hz
10^8	.1 Hz

7. RATIO

a. Set counter controls as follows:

FUNCTION ..... FREQ
MULTIPLIER ..... 10^1
SLOPE ..... +
AC/DC ..... AC
ATTEN X1
CHK-NORM ..... NORM
LEVEL ..... PRESET
OSC (rear panel) ..... EXT

b. Connect test oscillator to OSC jack, using BNC T. Connect oscilloscope to T connector, using 50-ohm feedthrough at oscilloscope BNC connector. Set oscillator output for 10 MHz at 2.8 volts peak-to-peak, as observed on oscilloscope.

c. Connect a second BNC T connector to counter INPUT A jack. Connect second test oscillator to T connector. Connect B channel of oscilloscope to front-panel T connector, using 50-ohm feed through at oscilloscope BNC connector. Set variable oscillator for 100 kHz at 100 mV rms display on oscilloscope.

d. Check that counter displays 100. Disregard units and decimal point readouts. Record on test card.

e. Repeat test using 100 Hz into OSC jack and 100 kHz into INPUT A. Set TIME BASE/MULTIPLIER to 10^3. Display should be ratio of two input frequencies x 10^3, approximately 10^6. Disregard units and decimal point. Record on test card.

8. GATE OUTPUT AND SAMPLE RATE

a. Disconnect setup.

b. Set counter controls as follows:

FUNCTION ..... FREQ
TIME BASE 1ms
CHK-NORM ..... CHK
FAST/NORM/HOLD ..... FAST
SAMPLE RATE ..... max ccw

Table 5-3. In-Cabinet Performance Check (Continued)

c. Using 10:1 divider probe, connect oscilloscope vertical input to GATE output and observe positive pulses ≥2.4 V with a pulse width of <100 μs. Record on test card.

d. Slowly rotate SAMPLE RATE clockwise and observe that the pulse width increases.

e. Set the TIME BASE switch to 10 ms and rotate the SAMPLE RATE fully clockwise. Observe that the pulse width is >20 ms. Record on test card.

f. Set FAST/NORM/HOLD to NORM and turn SAMPLE RATE fully counterclockwise, just out of OFF. Observe the positive pulse width is <20 ms. Record on test card.

g. Slowly rotate SAMPLE RATE clockwise, observing an increase in the pulse width.

h. Set TIME BASE to 1 sec and rotate SAMPLE RATE fully clockwise. Verify that the time between flashes of the gate (C) lamp is greater than 5 seconds. Record on test card.

i. Set FUNCTION to START and check that gate output is TTL Low (<0.4 V).

j. Set FUNCTION to STOP and verify that gate output is TTL High (>2.4 V).

9. DIGITAL RECORDER (Option 003)

a. Set counter controls as follows:

FUNCTION ..... FREQ
TIME BASE ..... 1 SEC
CHK-NORM ..... CHK
FAST/NORM/HOLD ..... NORM
SAMPLE RATE ..... Mid-Position

b. Connect oscilloscope to J9(48). Observe oscilloscope display a print command (drop from >2.4 to <0.4 V) immediately after the C lamp goes out.

c. Connect jumper from J9(25) to J9(22).

d. Check that counter main gate is inhibited. C light does not flash, and no print command pulses are generated.

e. Verify proper output by connecting a 5055A printer or interrogating lines with logic probe or voltmeter and performing display tube self-check in Section III.

10. PRESCALER (5327C ONLY)

Frequency Response and Sensitivity

a. Set counter controls as follows:

FUNCTION ..... FREQ
TIME BASE ..... 1 s
INPUT SELECTOR ..... B÷10

Table 5-3. In-Cabinet Performance Check (Continued)

c. Use the set of frequency generators (Table 5-2) necessary to cover the input frequency from 2 Hz to 550 MHz, while maintaining 25 mV rms input level. Adjust TIME BASE switch as necessary for best display.

e. Check for stable count within stability of oscillator.

d. Set INPUT SELECTOR switch to B.

e. Use the set of frequency generators necessary to cover the input frequency from 2 Hz to 50 MHz, while maintaining 15 mV rms input level. Adjust TIME BASE switch as necessary for best display.

f. Check for stable count within stability of oscillator.

Pulse Operation

a. Set pulse generator output to 10 MHz repetition rate, 10 ns wide pulses at 300 mV peak-to-peak. Connect pulse generator to INPUT B jack.

b. Check that counter displays repetition rate and that count light flashes.

c. Repeat above check at 10 kHz.

PERFORMANCE CHECK TEST CARD

Hewlett-Packard Model 5326C/5327C
Frequency Counter

Serial No. _____ / _____

Test Performed by _____

Date _____

DESCRIPTION	CHECK
1. TIME BASE STABILITY AND OUTPUT	
a. Oscillator	_____ Counter displays 000,0000
b. Line voltage variations of ±10%	_____ Frequency change is ≤±1 part in 10^7
c. Temperature variations between 0°C and 50°C	_____ Frequency change ≤ 2.5 parts in 10^6
d. Output at OSC jack	_____ 10 MHz at >2.4 V
2. DISPLAY, DECIMAL POINTS, AND DIVIDERS	_____ Operates in accordance with Table 3-3 procedures
3. FREQUENCY RESPONSE AND SENSITIVITY	
a. Test oscillator varies from 20 Hz	_____ Counter displays all frequencies in this range
b. Trigger level	_____ Trigger level is variable from +3 V to -3 V on + and - slopes
4. PULSE OPERATION	
a. Input at 10 MHz, 15 ns pulse width and 0.3 V peak-to-peak	_____ Counter displays repetition rate, gate light flashes, and trigger lamp is on
b. Input at 10 kHz, 15 ns pulse width and 0.3 V peak-to-peak	_____ Counter displays repetition rate, gate light flashes, and trigger lamp is on
5. PERIOD AVERAGE	
a. Test oscillator at 2 Hz, 100 mv	_____ Counter displays period of input signal (0.5 s)
b. Vary test oscillator from 2 Hz to 10 MHz at 100 mV	_____ Counter displays periods of frequencies in this range
6. TOTALIZE	
a. Totalizing internal clock pulses	_____ Display totalizes, gate light flashes, and trigger lamp lights
b. TIME BASE OUTPUT jack	_____ Scales output signal with setting of MULTIPLIER switch
7. RATIO	
a. 100 kHz on INPUT A, 10 MHz on OSC jack	_____ Counter displays 100
b. 100 kHz on INPUT A, 100 Hz on OSC jack	_____ Counter displays 10^6

PERFORMANCE CHECK TEST CARD

Hewlett-Packard Model 5326C/5327C Frequency Counter	Test Performed by
Serial No.	Date

DESCRIPTION		CHECK
8. GATE OUTPUT AND SAMPLE RATE		
a. SAMPLE RATE switch to FAST, control to max. ccw	_____	Pulse width is <100 μs at ≥2.4 V
b. SAMPLE RATE control max cw	_____	Pulse width is >20 ms
c. SAMPLE RATE switch to NORM, control to max ccw	_____	Pulse width is <20 ms
d. SAMPLE RATE control max. cw	_____	Display time is >5 s
9. DIGITAL RECORDER	_____	Printed output agrees with counter display
10. PRESCALER (5327C ONLY)		
Frequency Response and Sensitivity	_____	
Pulse Operation	_____	

Table 5-4. Adjustments

1. POWER SUPPLY A15
   a. Connect counter line cord to variable power transformer. Monitor output voltage with AC VTVM. Adjust transformer for 115 volt indication on VTVM.
   b. Turn counter SAMPLE RATE control clockwise out of OFF.
   c. Connect VTVM to A15 Pin 7 and adjust A15R10 for +16.5 volts.
   d. Connect VTVM to A15 Pin 6 and adjust A15R13 for -16.5 volts.

2. SENSITIVITY AND OFFSET A2
   a. Connect a BNC T connector to INPUT A jack.
   b. Connect test oscillator output to T connector.
   c. Connect oscilloscope vertical input to T connector, using 50-ohm feedthrough at oscilloscope input BNC.
   d. Using a clip lead, connect A16P1A(8) output to oscilloscope Z-axis input.
   e. Adjust test oscillator for 1 kHz output at 100 mV rms.
   f. Set counter controls as follows:

      FUNCTION ..... FREQ
      CHK-NORM ..... NORM
      ATTEN X1
      AC-DC ..... DC
      LEVEL ..... PRESET

   g. Set SLOPE switch to - and + positions and observe marker position on oscilloscope waveform.
   h. On Input Amplifier board A2, adjust A2R2 until + and - marker positions have a symmetrical offset about the zero volt axis for + and - slope switch positions.

3. OSCILLATOR A4
   a. Connect 1 MHz frequency standard to INPUT A jack.
   b. Set counter controls as follows:

      CHK-NORM ..... NORM
      FUNCTION ..... FREQ
      TIME BASE ..... 10 s
      SAMPLE RATE ..... slightly clockwise out of OFF

   c. Remove top cover.
   d. Using insulated tuning tool, adjust A4C3 until display indicates all zeros with cover on. (Wait 10 seconds between adjustments for counter to make measurement.)

NOTE

On standard instruments without Option 001, the counter display will overflow; however, all digits are valid.

Table 5-4. Adjustments (Continued)

4. PRESCALER ADJUSTMENTS (5327C ONLY)

a. Set counter controls as follows:

FUNCTION ..... FREQ
TIME BASE 0.1s
INPUT SELECTOR ..... B+10

b. With no input signal applied, adjust R3 offset pot for 0 V on U2 pin 4.

c. Adjust R10 bias pot for 0.65 ±.05 V on U2 pin 3.

d. Adjust R27 bias pot for 0.0 ±.05 V on U3 pin 3.

e. Check that the previously adjusted voltage on U2 pin 3 is correct. If voltage has shifted, adjust R10 for proper reading and recheck U3 pin 3.

f. Set HP VHF Signal Generator and doubler for 550 MHz at 1 V rms. Measure the output with an HP 3406A RF Voltmeter using a 50Ω termination at the probe. Connect signal source to INPUT B of counter.

g. Reduce output level until counter's display becomes unstable. Adjust R3 for a stable display. Repeat this procedure until unable to obtain a stable reading. Increase signal level until display just becomes stable.

h. Disconnect input and connect to voltmeter; reading should be 25 mV or less. Check other frequencies with the band.

i. Set INPUT SELECTOR switch to B.

j. Set input signal to 50 MHz at 15 mV and connect to INPUT B. Counter should display 50 MHz.

Table 5-5. Trouble Isolation

SYMPTOM COUNT PROBLEMS	INITIAL CONDITIONS	TEST POINT	EVALUATION	
			TEST IS POSITIVE	TEST IS NEGATIVE
1. COUNTER DOES NOT COUNT — HAS TRIGGER LIGHT BUT NO COUNT LIGHT (C)	For problem in one function only.	Check for a TTL low A7: Pin 1 for FREQ Pin 2 for PERIOD AVG Pin 4 for START	a. No input signal to A7. b. Problem is on A7.	Switch circuitry or wiring for specific mode is faulty
	For problem in all function modes. (Use Fast Gate Time when checking OTB signal). Start position may have count light.	1. Check for oscillator at A7(T).	Perform Step 2 of Test Point.	Problem is in oscillator circuit of A4 or A5
		2. Check for ITB signal at A7(U).	Perform Step 3 of Test Point.	a. MAIN GATE INHIBIT line is staying High, (Check A6 Inhibit circuits & A7U7A. b. No input signal to A7. c. A11(1) is High (also check A16CR1). d. Problem is on A7.
		3. Check for OTB signal at A7(V).	Problem is on A7.	a. A5 GATE ENABLE line is High. b. Problem is on A5.
2. COUNTER DOES NOT COUNT — NO TRIGGER LIGHT NO COUNT LIGHT (C)	Use an input signal with CHK/NORM switch set to NORM	1. Check A2P2(5 & 6) for input signal.	Perform Step 2 of Test Point.	Problem is on A1.
		2. Check for ECL Low at A2P1(4,D).	Problem is on A2.	A7 $\overline{\text{OSC CH}}$ circuit is bad.
3. COUNTER DOES NOT COUNT — HAS TRIGGER LIGHT HAS COUNT LIGHT (C)		1. Check for counted signal at A8J1(5).	a. No Transfer signal at A8P1(A). b. Problem is on A9.	a. A8P1(B) is always High. b. No input signal at A8P1(2). c. Problem is on A8.
4. INACCURACY IN COUNT	Place FUNCTION to START, connect known 1 MHz frequency standard.	1. Check for exact oscillator frequency at A4(1,A)	Perform Step 2 of Check Point.	Frequency must be adjusted for exactly 10 MHz.
		2. Check TIME BASE output jack (using another counter) for correct A5 scaling of oscillator frequency.	Problem is on A8 or A9.	Problem is on A5.
5. COUNTER TOTALIZES ALL MEASUREMENTS			No reset signal from A6(16).	
6. ONE DIGIT DOES NOT COUNT	Set counter display so that tube would normally count (use START/STOP).	Check A9 Circuitry for that position.		

Table 5-5. Trouble Isolation (Continued)

SYMPTOM DISPLAY PROBLEMS	INITIAL CONDITIONS	TEST POINT	EVALUATION	
			TEST IS POSITIVE	TEST IS NEGATIVE
1. NIXIES DO NOT LIGHT		Check A16 for +5 V, -5 V, and +175 V.	a. Problem on A8 or A9. b. A8 or A9 has bad connection.	a. Power not connected to counter. b. Blown line fuse. c. A15 or A16 power supply circuits are bad.
2. ONE NIXIE DOES NOT LIGHT	Set counter display so that tube would normally be lit.		Problem is on A9.	
3. UNLIT PORTION OF DISPLAYED DIGIT (HOLES)			Replace display tube.	
4. NIXIE DISPLAYS WRONG DIGIT	Set display on incorrect digit, using START/STOP switch.	Check A9 codes for that position.		
5. ONE DECIMAL POINT DOES NOT LIGHT	Set up combination of FUNCTION/TIME BASE switches.	Check for Low on DP line of A11.	Problem is on A8 or A9.	a. FUNCTION and/or TIME BASE lines are not pulled Low for A11. b. A11 circuitry is bad.
6. DECIMAL POINTS DO NOT LIGHT	For problem in Frequency Mode only, FUNCTION switch to FREQ	Check for Low at A11: Pin 3 for FREQ A or B Pin C for FREQ B÷10	Several IC's on A11 are bad	a. A10 input lines for FREQ are High. (One or more; A10(B) should be Low, A10(1) may be low, or A10(2) may be Low.) b. A10 circuitry is bad.
	For problem in Period Average Mode only, FUNCTION switch to PERIOD AVG.	Check for Low at A11: Pin 4 for Per Avg A or B Pin D for Per Avg B÷10	Several IC's on A11 are bad.	a. A10 input lines for Per Avg are High. (One or more; A10(A) should be Low, A10(1) may be Low, or A10(2) may be Low.) b. A10 circuitry is bad.
	For both Freq and Period Avg Modes (INPUT SELECTOR tried in different positions)	Check for Low on DP line at A8P1	A8 "Decimal Point Drivers" circuit is bad in common point.	a. A11(2) is High. b. A11(B) is High. c. A16CR2, 3 are bad.
7. ANNUNCIATOR DOES NOT LIGHT	Set front-panel controls for problem conditions.	For right readout, Check A10 for Low on selected function and time base lines.	Problem is on A10	Switch circuitry for line with High level is bad.
		For left readout, check for Low on A11 input line. (Overflow, C light, or EXT). Also, see "Count Problems."	Problem is on A11.	COUNT LIGHT-problem is on A5. OVERFLOW-problem is on A9. EXT-problem is in Option 002 wiring or pressure connector

Table 5-5. Trouble Isolation (Continued)

SYMPTOM DISPLAY PROBLEMS	INITIAL CONDITIONS	TEST POINT	EVALUATION	
			TEST IS POSITIVE	TEST IS NEGATIVE
8. DISPLAY DOES NOT STORE COUNT		Check STORAGE switch (rear panel) — must be on.	A6(8) is always Low.	Place switch to ON position.
9. COUNT LIGHT (C) DOES NOT LIGHT AT FAST GATE TIMES			Gate lamp one-shot on A5 is bad.	
INPUT PROBLEMS				
1. COUNTER MAKES MEASUREMENT HAS NO TRIGGER LIGHT		Check for trigger light pulses at A2P2(1)	Problem is on A1	Problem is in Trigger Light Driver circuit of A2.
2. CHECK MODE IS INOPERATIVE	CHK/NORM switch to CHK	1. Check for an ECL High at A2P1(C).	Perform step 2.	a. Wire to A1P1 is broken. b. Problem is on A1.
		2. Check for $\overline{\text{OSC CH}}$ signal at A2P1(4,D)	Problem is on A2.	Problem is on A7.
3. TRIGGER LEVEL DOES NOT COVER NORMAL RANGE		1. Check for +16.5 V and -16.5 V at A2 P1(6, F) and (7, H), respectively.	Perform step 2.	Problem is on A15.
		2. Check that A2P2(D) is adjustable from at least +3 V to -3 V with front-panel LEVEL control	Problem is on A2	Problem is on A1.

SECTION VI

REPLACEABLE PARTS

6-1. INTRODUCTION

6-2. This section contains information for ordering replacement parts. Table 6-1 lists parts in alphanumerical order of their reference designators and indicates the description and HP Part Number of each part, together with any applicable notes. The table includes the following information.

a. Description of part (see abbreviations below).

b. Typical manufacturer of the part in a five-digit code; see list of manufacturers in Table 6-2.

c. Manufacturer's part number.

d. Total quantity used in the instrument (TQ column).

6-3. Miscellaneous parts are listed at the end of Table 6-1.

6-4. ORDERING INFORMATION

6-5. To obtain replacement parts, address order of inquiry to your local Hewlett-Packard Sales and Service Office (see lists at rear of this manual for addresses). Identify parts by their Hewlett-Packard part numbers.

6-6. To obtain a part that is not listed, include:

a. Instrument model number.

b. Instrument serial number.

c. Description of the part.

d. Function and location of the part.

REFERENCE DESIGNATORS

A	assembly	F	fuse	MP	mechanical part	U	integrated circuit
B	motor	FL	filter	P	plug	V	vacuum, tube, neon bulb, photocell, etc.
BT	battery	IC	integrated circuit	Q	transistor		
C	capacitor	J	jack	R	resistor	VR	voltage regulator
CP	coupler	K	relay	RT	thermistor	W	cable
CR	diode	L	inductor	S	switch	X	socket
DL	delay line	LS	loud speaker	T	transformer	Y	crystal
DS	device signaling (lamp)	M	meter	TB	terminal board	Z	tuned cavity, network
E	misc electronic part	MK	microphone	TP	test point		

ABBREVIATIONS

A	amperes	H	henries	N/O	normally open	RMO	rack mount only
AFC	automatic frequency control	HDW	hardware	NOM	nominal	RMS	root-mean square
AMPL	amplifier	HEX	hexagonal	NPO	negative positive zero (zero temperature coefficient)	RWV	reverse working voltage
		HG	mercury				
BFO	beat frequency oscillator	HR	hour(s)	NPN	negative-positive-negative	S-B	slow-blow
BE CU	beryllium copper	HZ	hertz			SCR	screw
BH	binder head			NRFR	not recommended for field replacement	SE	selenium
BP	bandpass	IF	intermediate freq			SECT	section(s)
BRS	brass	IMPG	impregnated	NSR	not separately replaceable	SEMICON	semiconductor
BWO	backward wave oscillator	INCD	incandescent			SI	silicon
		INCL	include(s)			SIL	silver
CCW	counter-clockwise	INS	insulation(ed)	OBD	order by description	SL	slide
CER	ceramic	INT	internal	OH	oval head	SPG	spring
CMO	cabinet mount only	K	kilo = 1000	OX	oxide	SPL	special
COEF	coefficient					SST	stainless steel
COM	common	LH	left hand	P	peak	SR	split ring
COMP	composition	LIN	linear taper	PC	printed circuit	STL	steel
COMPL	complete	LK WASH	lock washer	PF	picofarads = 10^{-12} farads	TA	tantalum
CONN	connector	LOG	logarithmic taper			TD	time delay
CP	cadmium plate	LPF	low pass filter	PH BRZ	phosphor bronze	TGL	toggle
CRT	cathode-ray tube			PHL	Phillips	THD	thread
CW	clockwise	M	milli = 10^{-3}	PIV	peak inverse voltage	TI	titanium
		MEG	meg = 10^{6}	PNP	positive-negative-positive	TOL	tolerance
DEPC	deposited carbon	MET FLM	metal film			TRIM	trimmer
DR	drive	MET OX	metallic oxide	P/O	part of	TWT	traveling wave tube
ELECT	electrolytic	MFR	manufacturer	POLY	polystyrene	U	micro = 10^{-6}
ENCAP	encapsulated	MHZ	mega hertz	PORC	porcelain		
EXT	external	MINAT	miniature	POS	position(s)	VAR	variable
F	farads	MOM	momentary	POT	potentiometer	VDCW	dc working volts
FH	flat head	MOS	metal oxide substrate	PP	peak-to-peak		
FIL H	fillister head	MTG	mounting	PT	point	W	with
FXD	fixed	MY	"mylar"	PWV	peak working voltage	W	watts
G	giga (10^{9})	N	nano (10^{-9})	RECT	rectifier	WIV	working inverse voltage
GE	germanium	N/C	normally closed	RF	radio frequency		
GL	glass	NE	neon	RH	round head or right hand	WW	wirewound
GRD	ground(ed)	NI PL	nickel plate			W/O	without

01194-14

Figure 6-1. Panel Designations

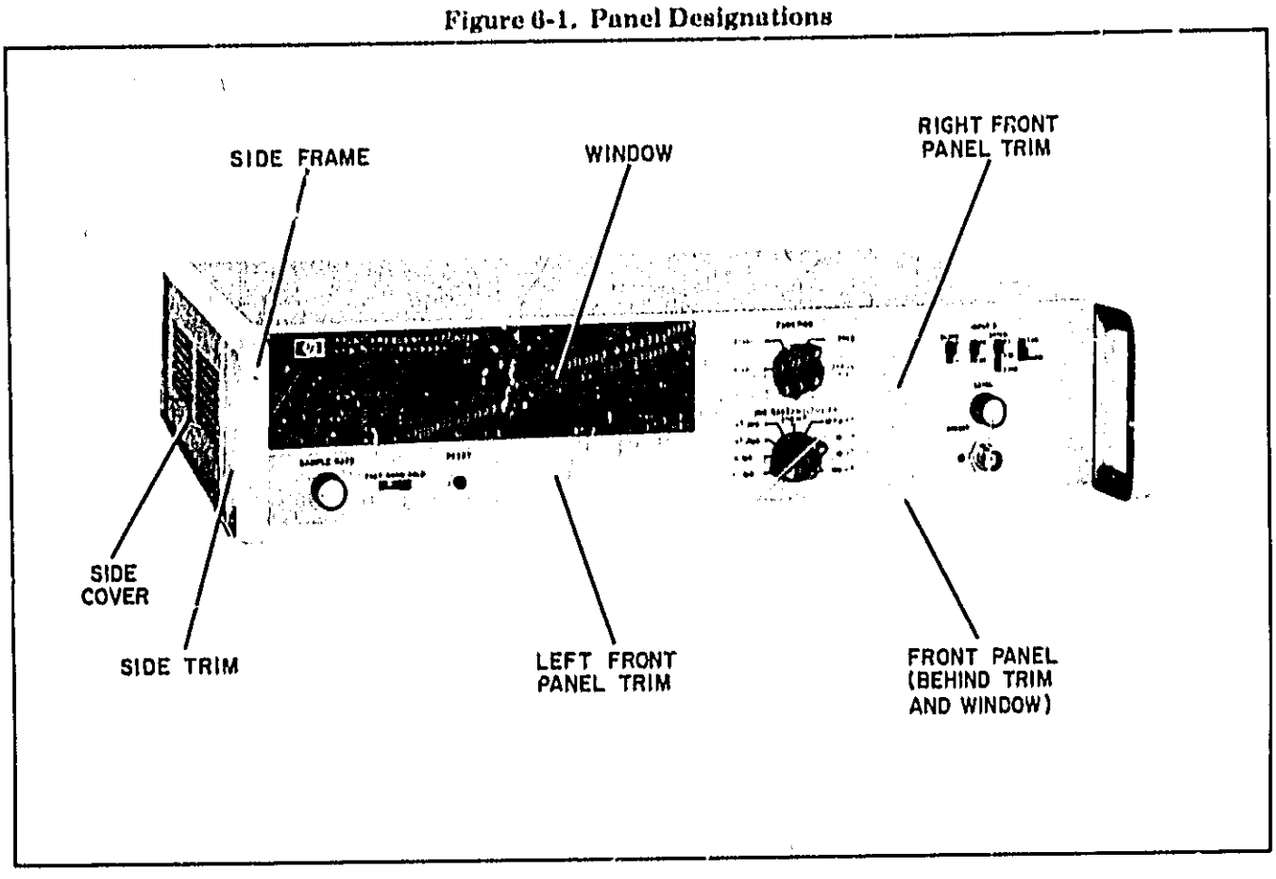


Table 6-1. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A1	05326-60048	1	BOARD ASSY:ATTENUATOR (SERIES 1224A) (LOADED ON 05326-60048 BLANK BOARD) NOTE 1:	28480	05326-60048
			A1R12 IS NOT INCLUDED WHEN A1 ATTEN. ASSY IS ORDERED; ORDER A1R12 SEPARATELY.		
A1C1	0160-2244	1	CAPACITOR:FXD CER 3.0PF+-0.25 PF 500VDCW	28480	0160-2244
A1C2	0160-0939	1	CAPACITOR:FXD MICA 430 PF 5% 300 VDCW	28480	0160-0939
A1C3	0160-0378	1	CAPACITOR:FXD MICA 27PF 5%	72136	RDM15E270J5S
A1C4	0160-0161	3	CAPACITOR:FXD MY 0.01 UF 10% 200VDCW	56289	192P10392-PTS
A1C5	0160-2140	1	CAPACITOR:FXD CER 470 PF +80-20% 1000VDCW	91418	TYPE B
A1C6	0160-2930	10	CAPACITOR:FXD CER 0.01 UF +80-20% 100VDCW	91418	TA
A1C7	0160-2197	1	CAPACITOR:FXD MICA 16 PF 5%	72136	RDM15C100J3C
A1C8	0160-2146	1	CAPACITOR:FXD CER 0.02 UF +80-20% 100VDCW	91418	TA
A1C9	0160-2930		CAPACITOR:FXD CER 0.01 UF +80-20% 100VDCW	91418	TA
A1CR1	1901-0040	19	DIODE:SILICON 50 MA 30 MV	07263	FDG1088
A1CR2	1910-0016	11	DIODE:GE 60 MIV	28480	1910-0016
A1CR3	1901-0376	2	DIODE:SILICON 35V	28480	1901-0376
A1CR4	1901-0376		DIODE:SILICON 35V	28480	1901-0376
A1CR5	1902-0041	2	DIODE:BREAKDOWN 5.11V 5%	04713	SZ10939-98
A1CR6	1902-0041		DIODE:BREAKDOWN 5.11V 5%	04713	SZ10939-98
A1DS1	2140-0047	1	LAMP:NEON GLOW 0.8 MILLIAMPS	08806	A1C
A1J1	1251-0472	1	CONNECTOR:PC 12 CONTACTS	71785	252-06-30-300
A1J2	1250-1163	1	CONNECTOR:RF BNC INPUT	28480	1250-1163
A1P1	0360-0451	1	TERMINAL:SOLDER STUD 0.040" DIA SHANK	00000	OBD
A1Q1	1855-0334	1	TST:FET DUAL N-CHANNEL	17856	DN377
A1R1	0683-2235	2	RESD COMP 22K OHM 5% 1/4W	01121	CB 2235
A1R2	0683-9145	1	RESD COMP 910K OHM 5% 1/4W	01121	CB 9145
A1R3	0683-1015	14	RESD COMP 100 OHM 5% 1/4W	01121	CB 1015
A1R4	0683-9125	1	RESD COMP 9100 OHM 5% 1/4W	01121	CB 9125
A1R5	0698-3576	2	RESD COMP 110K OHM 5% 1/4W	28480	0698-3576
A1R6	0683-1055	2	RESD COMP 1 MEGOHM 5% 1/4W	01121	CB 1055
A1R7	0698-3576		RESD COMP 110K OHM 5% 1/4W	28480	0698-3576
A1R8	0683-2215	4	RESD COMP 220 OHM 5% 1/4W	01121	CB 2215
A1R9	0683-4715	4	RESD COMP 470 OHM 5% 1/4W	01121	CB 4715
A1R10	[illegible] 1055		RESD COMP 1 MEGOHM 5% 1/4W	01121	CB 1055
A1R11	0683-3325	12	RESD COMP 3300 OHM 5% 1/4W	01121	CB 3325
A1R12	2100-3228	1	RVAR COMP 10K OHM 20% LIN 1/2W (SEE NOTE 1 ABOVE)	28480	2100-3228
A1R13	0683-2225	8	RESD COMP 2.2K OHM 5% 1/4W	01121	CB 2225
A1R14	0683-2225		RESD COMP 2.2K OHM 5% 1/4W	01121	CB 2225
A1S1	3101-1278	2	SWITCH:SLIDE DPDT (CHK-NORM)	79727	G-126-0007
A1S1					
A1S2	3101-1279	1	SWITCH:SLIDE DP 3 POSITIONS (ATTEN)	79727	G-128-5-0016
A1S2					
A1S3	3101-1311	3	SWITCH:SLIDE DPDT 0.5A 125V AC/DC (AC/DC)	79727	G126-0020
A1S3					
A1S4	3101-1278		SWITCH:SLIDE DPDT (SLOPE)	79727	G-126-0007
A1S4					
A1S5			PART OF A1R12.		
A1X	0380-0046	1	SPACER:CAPTIVE	00000	OBD
A1Y	01821-67401	2	XTAL:TRIGGER LEVEL	28480	01821-67401
A1Y					
A1Y					
A1Y					
A2	05326-60004	1	INPUT AMPLIFIER ASSY (SERIES 972) (LOADED ON 05326-20004 BLANK BOARD)	28480	05326-60004
A2C1	0160-2930		CAPACITOR:FXD CER 0.01 UF +80-20% 100VDCW	91418	TA
A2C2	0160-2930		CAPACITOR:FXD CER 0.01 UF +80-20% 100VDCW	91418	TA
A2C3	0160-2930		CAPACITOR:FXD CER 0.01 UF +80-20% 100VDCW	91418	TA
A2C4	0180-0197	4	CAPACITOR:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A2C5	0180-0197		CAPACITOR:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A2C6	0160-0153	3	CAPACITOR:FXD MY 0.001 UF 10% 200VDCW	56289	192P10292-PTS
A2C7	0170-0055	2	CAPACITOR:FXD MY 0.1UF 20% 200VDCW	56289	192P10402
A2C8	0170-0055		CAPACITOR:FXD MY 0.1UF 20% 200VDCW	56289	192P10402
A2C9	0160-2930		CAPACITOR:FXD CER 0.01 UF +80-20% 100VDCW	91418	TA
A2C10	0160-2930		CAPACITOR:FXD CER 0.01 UF +80-20% 100VDCW	91418	TA
A2CR1	1902-0049	1	DIODE:BREAKDOWN 6.19V 5%	04713	SZ10939-122
A2CR2	1910-0016		DIODE:GE 60 MIV	28480	1910-0016
A2CR3	1901-0040		DIODE:SILICON 50 MA 30 MV	07263	FDG1088
A2CR4	1910-0016		DIODE:GE 60 MIV	28480	1910-0016

See Introduction to this section for ordering information

Table 6-1. Replaceable Parts (Continued)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A2CR5	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1086
A2L2	9100-2255	2	COIL/CHOKE 0.47 UH 10%	28480	9100-2255
A2L3	9140-0144		COIL:FXD RF 4.7 UH	28480	9140-0144
A2L4	9140-0144		COIL:FXD RF 4.7 UH	28480	9140-0144
A2L5	9100-2255		COIL/CHOKE 0.47 UH 10%	28480	9100-2255
A2L6	9140-0144		COIL:FXD RF 4.7 UH	28480	9140-0144
A2L7	9140-0144		COIL:FXD RF 4.7 UH	28480	9140-0144
A2L8	9140-0142	1	COIL:FXD RF 2.20 UH 10%	82142	CS-4436-4R
A2L9	9140-0144		COIL:FXD RF 4.7 UH	28480	9140-0144
A2L10	9140-0144		COIL:FXD RF 4.7 UH	28480	9140-0144
A2Q1	1854-0092	14	TSTR:SI NPN	80131	2N3563
A2Q2	1853-0015	9	TSTR:SI PNP	80131	2N3640
A2Q3	1853-0015		TSTR:SI PNP	80131	2N3640
A2Q4	1854-0345	3	TSTR:SI NPN	80131	2N5179
A2Q5	1854-0345		TSTR:SI NPN	80131	2N5179
A2Q6	1853-0015		TSTR:SI PNP	80131	2N3640
A2Q7	1853-0015		TSTR:SI PNP	80131	2N3640
A2Q8	1854-0092		TSTR:SI NPN	80131	2N3563
A2Q9	1853-0015		TSTR:SI PNP	80131	2N3640
A2Q10	1853-0015		TSTR:SI PNP	80131	2N3640
A2Q11	1853-0015		TSTR:SI PNP	80131	2N3640
A2Q12	1853-0015		TSTR:SI PNP	80131	2N3640
A2Q13	1853-0015		TSTR:SI PNP	80131	2N3640
A2Q14	1854-0092		TSTR:SI NPN	80131	2N3563
A2Q15	1854-0071	19	TSTR:SI NPN:SELECTED FROM 2N3704	28480	1854-0071
A2Q16	1854-0092		TSTR:SI NPN	80131	2N3563
A2Q17	1854-0092		TSTR:SI NPN	80131	2N3563
A2Q18	1854-0365	7	TSTR:SI NPN	80131	2N4410
A2Q19	1854-0092		TSTR:SI NPN	80131	2N3563
A2Q20	1854-0071		TSTR:SI NPN:SELECTED FROM 2N3704	28480	1854-0071
A2R1	0683-6835	2	R:FXD COMP 68K OHM 5% 1/4W	01121	CB 6835
A2R2	2100-2520	1	R:VAR CERMET 50 OHM 20% TYPE V 1/2W	28480	2100-2520
A2R3	0683-2215		R:FXD COMP 220 OHM 5% 1/4W	01121	CB 2215
A2R4	0683-2405	1	R:FXD COMP 24 OHM 5% 1/4W	01121	CB 2405
A2R5	0683-3625	2	R:FXD COMP 3600 OHM 5% 1/4W	01121	CB 3625
A2R6	0683-1015		R:FXD COMP 100 OHM 5% 1/4W	01121	CB 1015
A2R7	0683-3025	6	R:FXD COMP 3000 OHM 5% 1/4W	01121	CB 3025
A2R8	0683-1025	27	R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A2R9	0698-3113	3	R:FXD CARBON 100 OHM 5% 1/8W	28480	0698-3113
A2R10	0698-3381	2	R:FXD COMP 150 OHM 5% 1/8W	28480	0698-3381
A2R11	0698-5175	2	R:FXD COMP 360 OHM 5% 1/8W	28480	0698-5175
A2R12	0698-3379	1	R:FXD COMP 68 OHM 5% 1/8W	28480	0698-3379
A2R13	0698-3375	1	R:FXD COMP 33 OHM 5% 1/8W	28480	0698-3375
A2R14	0683-1525	10	R:FXD COMP 1500 OHM 5% 1/4W	01121	CB 1525
A2R15	0698-5180	3	R:FXD COMP 2K OHM 5% 1/8W	28480	0698-5180
A2R16	0698-5175		R:FXD COMP 360 OHM 5% 1/8W	28480	0698-5175
A2R17	0698-3381		R:FXD COMP 150 OHM 5% 1/8W	28480	0698-3381
A2R18	0683-1025		R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A2R19	0698-3113		R:FXD CARBON 100 OHM 5% 1/8W	28480	0698-3113
A2R20	0683-1015		R:FXD COMP 100 OHM 5% 1/4W	01121	CB 1015
A2R21	0683-3025		R:FXD COMP 3000 OHM 5% 1/4W	01121	CB 3025
A2R22	0683-3625		R:FXD COMP 3600 OHM 5% 1/4W	01121	CB 3625
A2R23	0683-2225		R:FXD COMP 2.2K OHM 5% 1/4W	01121	CB 2225
A2R24	2100-2521	1	R:VAR FLM 2000 OHM 10% LIN 1/2W	28480	2100-2521
A2R25	0683-2225		R:FXD COMP 2.2K OHM 5% 1/4W	01121	CB 2225
A2R26	0683-1015		R:FXD COMP 100 OHM 5% 1/4W	01121	CB 1015
A2R27	0683-1015		R:FXD COMP 100 OHM 5% 1/4W	01121	CB 1015
A2R28	0683-6815	6	R:FXD COMP 680 OHM 5% 1/4W	01121	CB 6815
A2R29	0683-6815		R:FXD COMP 680 OHM 5% 1/4W	01121	CB 6815
A2R30	0683-4725	3	R:FXD COMP 4700 OHM 5% 1/4W	01121	CB 4725
A2R31	0683-1035	17	R:FXD COMP 10K OHM 5% 1/4W	01121	CB 1035
A2R32	0683-3315	2	R:FXD COMP 330 OHM 5% 1/4W	01121	CB 3315
A2R33	0683-1035		R:FXD COMP 10K OHM 5% 1/4W	01121	CB 1035
A2R34	0683-3315		R:FXD COMP 330 OHM 5% 1/4W	01121	CB 3315
A2R35	0683-1035		R:FXD COMP 10K OHM 5% 1/4W	01121	CB 1035
A2R36	0683-1015		R:FXD COMP 100 OHM 5% 1/4W	01121	CB 1015
A2R37	0683-2235		R:FXD COMP 22K OHM 5% 1/4W	01121	CB 2235
A2R38	0683-1025		R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A2R39	0683-2215		R:FXD COMP 220 OHM 5% 1/4W	01121	CB 2215
A2R40	0683-2225		R:FXD COMP 2.2K OHM 5% 1/4W	01121	CB 2225
A2R41	0683-1525		R:FXD COMP 1500 OHM 5% 1/4W	01121	CB 1525
A2R42	0683-1025		R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A2R43	0683-3035	1	R:FXD COMP 30K OHM 5% 1/4W	01121	CB 3035
A2R44	0683-3015	6	R:FXD COMP 300 OHM 5% 1/4W	01121	CB 3015
A2R45	0683-3315		R:FXD COMP 330 OHM 5% 1/4W	01121	CB 3315

See introduction to this section for ordering information

Table 6-1. Replaceable Parts (Continued)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A2R46	0683-1025		RESISTOR 1000 OHM 5% 1/4W	01121	CB 1025
A2R47	0683-1065	1	RESISTOR 10M OHM 5% 1/4W	01121	CB 1065
A2R48	0683-2055	1	RESISTOR 2 MEGOHM 5% 1/4W	01121	CB 2055
A2R49	0683-2715	1	RESISTOR 270 OHM 5% 1/4W	01121	CB 2715
A2R50	0683-2715		RESISTOR 270 OHM 5% 1/4W	01121	CB 2715
A2U1	1820-0238	1	INTEGRATED CIRCUIT:DTL, 2 INPUT NOR GATE	04713	MC 1810P
A2U2	1820-0142	2	INTEGRATED CIRCUIT:4-INPUT,2-OR/NOR	04713	MC1004P
A3			NOT ASSIGNED		
A4	05326-60002	1	OSCILLATOR ASSY (SERIES 1032) (LOADED ON 05326-20002 BLANK BOARD)	28480	05326-60002
A4C1	0160-0161		CAPACITOR-FXD 0.01 UF 10% 200VDCW	56289	192P10392-PT5
A4C2	0180-0197		CAPACITOR-FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A4C3	0121-0059	1	CAPACITOR-VAR CER 2-8 PF 300VDCW	28480	0121-0059
A4C4	0160-2264	1	CAPACITOR-FXD CER 20 PF 5% 500VDCW	72982	301-000-C0G0-200J
A4C5	0160-2930		CAPACITOR-FXD CER 0.01 UF +80-20% 100VDCW	91418	TA
A4L1	9100-2276	1	COIL/CHOKE 100 UH 10%	28480	9100-2276
A4Q1	1850-0158	1	TRANSISTOR PNP	80131	2N2635
A4R1	0698-4037	1	RESISTOR-NET FLM 46.4 OHM 1% 1/8W	28480	0698-4037
A4R2	0683-1025		RESISTOR 1000 OHM 5% 1/4W	01121	CB 1025
A4R3	0683-3015		RESISTOR 300 OHM 5% 1/4W	01121	CB 3015
A4R4	0683-3015		RESISTOR 300 OHM 5% 1/4W	01121	CB 3015
A4U1	1820-0142		INTEGRATED CIRCUIT:4-INPUT,2-OR/NOR	04713	MC1004P
A4Y1	0410-0405	1	CRYSTAL:QUARTZ 10 MHZ	28480	0410-0405
A5	05326-60005	1	TIME BASE CONTROL ASSY (SERIES 972) (LOADED ON 05326-20005 BLANK BOARD)	28480	05326-60005
A5C1	0180-0197		CAPACITOR-FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A5C2	0160-0127	1	CAPACITOR-FXD CER 1.0 UF 20% 25VDCW	56289	5C13C5-CML
A5C3	0180-0291	2	CAPACITOR-FXD ELECT 1.0 UF 10% 35VDCW	56289	150D1C5X9035A2-DYS
A5C4	0160-2150	1	CAPACITOR-FXD MICA 33 PF 5%	28480	0160-2150
A5C5	0160-2204	2	CAPACITOR-FXD MICA 100PF 5%	72136	RDM15F101J3C
A5CR1	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A5Q1	1854-0092		TRANSISTOR NPN	80131	2N3563
A5Q2	1854-0092		TRANSISTOR NPN	80131	2N3563
A5Q3	1854-0071		TRANSISTOR NPN:SELECTED FROM 2N3704)	28480	1854-0071
A5Q4	1854-0071		TRANSISTOR NPN:SELECTED FROM 2N3704)	28480	1854-0071
A5Q5	1854-0071		TRANSISTOR NPN:SELECTED FROM 2N3704)	28480	1854-0071
A5Q6	1854-0071		TRANSISTOR NPN:SELECTED FROM 2N3704)	28480	1854-0071
A5R1	0683-1035		RESISTOR 10K OHM 5% 1/4W	01121	CB 1035
A5R2	0683-1035		RESISTOR 10K OHM 5% 1/4W	01121	CB 1035
A5R3	0683-5105	3	RESISTOR 51 OHM 5% 1/4W	01121	CB 5105
A5R4	0683-3325		RESISTOR 3300 OHM 5% 1/4W	01121	CB 3325
A5R5	0683-4715		RESISTOR 470 OHM 5% 1/4W	01121	CB 4715
A5R6	0683-3325		RESISTOR 3300 OHM 5% 1/4W	01121	CB 3325
A5R7	0683-1225	1	RESISTOR 1200 OHM 5% 1/4W	01121	CB 1225
A5R8	0683-1025		RESISTOR 1000 OHM 5% 1/4W	01121	CB 1025
A5R9	0683-1025		RESISTOR 1000 OHM 5% 1/4W	01121	CB 1025
A5R10	0683-2215		RESISTOR 220 OHM 5% 1/4W	01121	CB 2215
A5R11	0683-6835		RESISTOR 68K OHM 5% 1/4W	01121	CB 6835
A5R12	0683-3325		RESISTOR 3300 OHM 5% 1/4W	01121	CB 3325
A5R13	0683-3325		RESISTOR 3300 OHM 5% 1/4W	01121	CB 3325
A5R14	0683-3325		RESISTOR 3300 OHM 5% 1/4W	01121	CB 3325
A5R15	0683-3325		RESISTOR 3300 OHM 5% 1/4W	01121	CB 3325
A5R16	0683-1025		RESISTOR 1000 OHM 5% 1/4W	01121	CB 1025
A5R17	0683-1025		RESISTOR 1000 OHM 5% 1/4W	01121	CB 1025
A5R18	0683-2225		RESISTOR 2.2K OHM 5% 1/4W	01121	CB 2225
A5R19	0683-2225		RESISTOR 2.2K OHM 5% 1/4W	01121	CB 2225
A5R20	0683-5105		RESISTOR 51 OHM 5% 1/4W	01121	CB 5105
A5R21	0683-5105		RESISTOR 51 OHM 5% 1/4W	01121	CB 5105
A5U1	1820-0413	7	INTEGRATED CIRCUIT:DECADE DIVIDER	28480	1820-0413
A5U2	1820-0413		INTEGRATED CIRCUIT:DECADE DIVIDER	28480	1820-0413
A5U3	1820-0413		INTEGRATED CIRCUIT:DECADE DIVIDER	28480	1820-0413
A5U4	1820-0413		INTEGRATED CIRCUIT:DECADE DIVIDER	28480	1820-0413
A5U5	1820-0064	4	IC:TTL QUAD 2-INPT NAND GATE	01295	SN7400N
A5U6	1820-0413		INTEGRATED CIRCUIT:DECADE DIVIDER	28480	1820-0413

Table 6-1. Replaceable Parts (Continued)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A5U7	1820-0413		INTEGRATED CIRCUIT:DECADE DIVIDER	28480	1820-0413
A5U8	1820-0413		INTEGRATED CIRCUIT:DECADE DIVIDER	28480	1820-0413
A5U9	1820-0413	1	IC:TTL DECADE DIVIDER 12.5 MHZ MIN.	28480	1820-0413
A5U10	1820-0174	1	IC:TTL HEX INVERTER	01295	SN7404N
A6	05326-60013	1	SAMPLE RATE ASSY (SCALES 1224A) (ORDERED ON 05326-60011 BLANK BOARD)	28480	05326-60013
A6C1	0160-2201	1	CAPACITOR-FXD MICA 51 PF 5%	72136	RDM15E510J3C
A6C2	0160-3134	1	CAPACITOR-FXD MICA 220PF 5% 300VDCW	14655	RDM15F221J3C
A6C3	0180-0226	1	CAPACITOR-FXD ELECT 22 UF 10% 15VDCW	56289	150D226X9015B2-DYS
A6C4	0160-0166	1	CAPACITOR-FXD MY 0.068 UF 10% 200VDCW	56289	192P68392-PTS
A6C5	0140-0193	1	CAPACITOR-FXD MICA 82 PF 5%	28480	0140-0193
A6C6	0160-0153		CAPACITOR-FXD MY 0.001 UF 10% 200VDCW	56289	192P10292-PTS
A6C7	0160-2199	2	CAPACITOR-FXD MICA 30 PF 5% 300VDCW	28480	0160-2199
A6C8	0160-0153		CAPACITOR-FXD MY 0.001 UF 10% 200VDCW	56289	192P10292-PTS
A6C9	0180-0291		CAPACITOR-FXD ELECT 1.5 UF 10% 35VDCW	56289	150D155X9035A2-DYS
A6C10	0160-0161		CAPACITOR-FXD MY 0.01 UF 10% 200VDCW	56289	192P10392-PTS
A6C11	0180-0114	6	CAPACITOR-FXD ELECT 4.0 UF +100-10% 25VDCW	28480	0180-0114
A6C12	0180-0114		CAPACITOR-FXD ELECT 4.0 UF +100-10% 25VDCW	28480	0180-0114
A6CR1	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FUG10P8
A6CR2	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FUG1088
A6CR3	1910-0016		DIODE:GE 60 WIV	28480	1910-0016
A6CR4	1910-0016		DIODE:GE 60 WIV	28480	1910-0016
A6CR5	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FUG1088
A6CR7	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FUG1088
A6CR8	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FUG10P8
A6CR9	1910-0016		DIODE:GE 60 WIV	28480	1910-0016
A6CR10	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FUG1088
A6CR11	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FUG1088
A6Q1	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A6Q2	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A6Q3	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A6Q4	1854-0069	9	TSTR:SI NPN	80131	2N769
A6Q5	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A6Q6	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A6Q7	1854-0215	3	TSTR:SI NPN	80131	2N3904
A6Q8	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A6Q9	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A6Q10	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A6Q11	1854-0069		TSTR:SI NPN	80131	2N769
A6Q12	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A6Q13	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A6R1	0683-1015		RESISTOR-FXD COMP 100 OHM 5% 1/4W	01121	CB 1015
A6R2	0683-1525		RESISTOR-FXD COMP 1500 OHM 5% 1/4W	01121	CB 1525
A6R3	0683-5125	8	RESISTOR-FXD COMP 5100 OHM 5% 1/4W	01121	CB 5125
A6R4	0683-1035		RESISTOR-FXD COMP 10K OHM 5% 1/4W	01121	CB 1035
A6R5	0683-1035		RESISTOR-FXD COMP 10K OHM 5% 1/4W	01121	CB 1035
A6R6	0683-5125		RESISTOR-FXD COMP 5100 OHM 5% 1/4W	01121	CB 5125
A6R7	0683-1035		RESISTOR-FXD COMP 10K OHM 5% 1/4W	01121	CB 1035
A6R8	0683-3325		RESISTOR-FXD COMP 3300 OHM 5% 1/4W	01121	CB 3325
A6R9	0683-3015		RESISTOR-FXD COMP 300 OHM 5% 1/4W	01121	CB 3015
A6R10	0683-2025	10	RESISTOR-FXD COMP 2000 OHM 5% 1/4W	01121	CB 2025
A6R11	0683-2735	4	RESISTOR-FXD COMP 27K OHM 5% 1/4W	01121	CB 2735
A6R12	0683-5125		RESISTOR-FXD COMP 5100 OHM 5% 1/4W	01121	CB 5125
A6R13	0683-3325		RESISTOR-FXD COMP 3300 OHM 5% 1/4W	01121	CB 3325
A6R14	0683-1035		RESISTOR-FXD COMP 10K OHM 5% 1/4W	01121	CB 1035
A6R15	0683-3325		RESISTOR-FXD COMP 3300 OHM 5% 1/4W	01121	CB 3325
A6R16	0683-5125		RESISTOR-FXD COMP 5100 OHM 5% 1/4W	01121	CB 5125
A6R17	0683-3325		RESISTOR-FXD COMP 3300 OHM 5% 1/4W	01121	CB 3325
A6R18	0683-3325		RESISTOR-FXD COMP 3300 OHM 5% 1/4W	01121	CB 3325
A6R19	0683-5115	4	RESISTOR-FXD COMP 510 OHM 5% 1/4W	01121	CB 5115
A6R20	0683-2735		RESISTOR-FXD COMP 27K OHM 5% 1/4W	01121	CB 2735
A6R21	0683-1035		RESISTOR-FXD COMP 10K OHM 5% 1/4W	01121	CB 1035
A6R22	0683-3915	1	RESISTOR-FXD COMP 390 OHM 5% 1/4W	01121	CB 3915
A6R23	0683-2025		RESISTOR-FXD COMP 2000 OHM 5% 1/4W	01121	CB 2025
A6R24	0683-6215	1	RESISTOR-FXD COMP 620 OHM 5% 1/4W	01121	CB 6215
A6R25	0683-1525		RESISTOR-FXD COMP 1500 OHM 5% 1/4W	01121	CB 1525
A6R26	0683-2025		RESISTOR-FXD COMP 2000 OHM 5% 1/4W	01121	CB 2025
A6R27	0683-3025		RESISTOR-FXD COMP 3000 OHM 5% 1/4W	01121	CB 3025
A6R28	0683-9115	2	RESISTOR-FXD COMP 910 OHM 5% 1/4W	01121	CB 9115
A6R29	0683-1525		RESISTOR-FXD COMP 1500 OHM 5% 1/4W	01121	CB 1525
A6R30	0683-2415	1	RESISTOR-FXD COMP 240 OHM 5% 1/4W	01121	CB 2415

See introduction to this section for ordering information

Table 6-1. Replaceable Parts (Continued)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A6R31	0683-1035		RESD COMP 10K OHM 5% 1/4W	01121	CB 1035
A6R32	0683-1035		RESD COMP 10K OHM 5% 1/4W	01121	CB 1035
A6R33	0683-2735		RESD COMP 27K OHM 5% 1/4W	01121	CB 2735
A6R34	0683-2735		RESD COMP 27K OHM 5% 1/4W	01121	CB 2735
A6R35	0683-1035		RESD COMP 10K OHM 5% 1/4W	01121	CB 1035
A6R36	0683-1035		RESD COMP 10K OHM 5% 1/4W	01121	CB 1035
A6R37	0683-2045	1	RESD COMP 200K OHM 5% 1/4W	01121	CB 2045
A6R38	0683-1035		RESD COMP 10K OHM 5% 1/4W	01121	CB 1035
A6R39	0683-1035		RESD COMP 10K OHM 5% 1/4W	01121	CB 1035
A6R40	0683-4735	2	RESD COMP 47K OHM 5% 1/4W	01121	CB 4735
A6R41	0683-1525		RESD COMP 1500 OHM 5% 1/4W	01121	CB 1525
A6R42	0683-1015		RESD COMP 100 OHM 5% 1/4W	01121	CB 1015
A6R43	0683-4735		RESD COMP 47K OHM 5% 1/4W	01121	CB 4735
A6R44	0683-1015		RESD COMP 100 OHM 5% 1/4W	01121	CB 1015
A6U1	1820-00[illegible]		IC:TTL QUAD 2-INPT NAND GATE	01295	SN7400N
A6U2	1820-0[illegible]	1	IC:ECL TYPE D F/F	04713	MC1022P
A6U3	1820-0068	1	IC:TTL TRIPLE 3-INPUT POS NAND GATE	12040	SN7410N
A6U4	1820-0054		IC:TTL QUAD 2-INPT NAND GATE	01295	SN7400N
A6U5	1820-0328	1	IC:TTL QUAD 2-INPT NOR GATE	04713	SN74C2N
A6U6	1820-0147	1	IC:ECL TRIPLE 3-INPT NOR GATE	04713	MC1007P
A7	05326-60045	1	BOARD ASSY:FUNCTION CONTROL (SERIES 1336A) (LOADED ON 05326-20045 BLANK BOARD)	28480	05326-60045
A7C1	0160-2199	1	C:FXD MICA 30 PF 5%	28480	0160-2199
A7C2	0140-0201	1	C:FXD MICA 12 PF 5%	28480	0140-0201
A7C3	0160-2327	7	C:FXD CER 1000 PF 20% 100VDCW	96733	B1C4BX102M
A7C4	0160-2327		C:FXD CER 1000 PF 20% 100VDCW	96733	B1C4BX102M
A7C5	0160-2327		C:FXD CER 1000 PF 20% 100VDCW	96733	B1C4BX102M
A7C6	0160-2327		C:FXD CER 1000 PF 20% 100VDCW	96733	B1C4BX102M
A7C7	0160-2327		C:FXD CER 1000 PF 20% 100VDCW	96733	B1C4BX102M
A7C8	0160-2327		C:FXD CER 1000 PF 20% 100VDCW	96733	B1C4BX102M
A7C9	0160-2327		C:FXD CER 1000 PF 20% 100VDCW	96733	B1C4BX102M
A7Q1	1854-0215		TSTR:SI NPN	80131	2N3904
A7Q2	1854-0215		TSTR:SI NPN	80131	2N3904
A7Q3	1854-0009		TSTR:SI NPN	80131	2N709
A7Q4	1854-0009		TSTR:SI NPN	80131	2N709
A7Q5	1854-0009		TSTR:SI NPN	80131	2N709
A7R1	0683-2425	3	RESD COMP 2400 OHM 5% 1/4W	01121	CB 2425
A7R2	0683-2425		RESD COMP 2400 OHM 5% 1/4W	01121	CB 2425
A7R3	0683-4315	6	RESD COMP 430 OHM 5% 1/4W	01121	CB 4315
A7R4	0683-1525		RESD COMP 1500 OHM 5% 1/4W	01121	CB 1525
A7R5	0683-2025		RESD COMP 2000 OHM 5% 1/4W	01121	CB 2025
A7R6	0683-1525		RESD COMP 1500 OHM 5% 1/4W	01121	CB 1525
A7R7	0683-2025		RESD COMP 2000 OHM 5% 1/4W	01121	CB 2025
A7R8	0683-5125		RESD COMP 5100 OHM 5% 1/4W	01121	CB 5125
A7R9	0683-1015	1	RESD COMP 100 OHM 5% 1/4W	01121	CB 1015
A7R10	0683-2725	3	RESD COMP 2700 OHM 5% 1/4W	01121	CB 2725
A7R11	0683-4715		RESD COMP 470 OHM 5% 1/4W	01121	CB 4715
A7R12	0683-7515	1	RESD COMP 750 OHM 5% 1/4W	01121	CB 7515
A7R13	0683-4325	1	RESD COMP 4300 OHM 5% 1/4W	01121	CB 4325
A7R14	0683-1025		RESD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A7R15	0683-7515		RESD COMP 750 OHM 5% 1/4W	01121	CB 7515
A7R16	0683-1025		RESD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A7R17	0683-4715		RESD COMP 470 OHM 5% 1/4W	01121	CB 4715
A7R18	0683-3015		RESD COMP 300 OHM 5% 1/4W	01121	CB 3015
A7R19	0683-7515		RESD COMP 750 OHM 5% 1/4W	01121	CB 7515
A7R20	0683-3015		RESD COMP 300 OHM 5% 1/4W	01121	CB 3015
A7R21	0683-3025		RESD COMP 3000 OHM 5% 1/4W	01121	CB 3025
A7R22	0683-9115		RESD COMP 910 OHM 5% 1/4W	01121	CB 9115
A7R23	0683-5615	1	RESD COMP 560 OHM 5% 1/4W	01121	CB 5615
A7R24	0683-1525		RESD COMP 1500 OHM 5% 1/4W	01121	CB 1525
A7U1	1820-0145	1	IC:DIGITAL QUAD 2-INPT NOR GATE	28480	1820-0145
A7U2	1820-0440	1	IC:ECL DUAL RS F/F	04713	MC1016P
A7U3	1820-0102	4	INTEGRATED CIRCUIT:J-K FLIP FLOP	04713	MC1013P
A7U4	1820-0212	1	IC:ECL QUAD LINE RECEIVER	04713	MC1020P
A7U5	1820-0489	3	IC:ECL	28480	1820-0489
A7U6	1820-0489		IC:ECL	28480	1820-0489
A7U7	1820-0252	1	IC:ECL DUAL 3-4 INPT OR/NOR GATE	04713	MC1026P
A7U8	1820-0253	1	INTEGRATED CIRCUIT:DIGITAL ECL DUAL	04713	MC1035P

Table 6-1. Replaceable Parts (Continued)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A8	05326-60009	1	DISPLAY SUPPORT ASSY (SERIES 944) (LOADED ON 05326-20009 BLANK BOARD)	28480	05326-[illegible]
A8C1	0160-2930		CAPACITOR-FXD CER 0.01 UF +80-20% 100VDCW	91418	TA
A8C2	0160-2199		CAPACITOR-FXD MICA 30 PF 5% 300VDCW	28480	0160-2199
A8CR1	1901-0040		DIODE-SILICON 50 MA 30 WV	07263	FD1008
A8CR2	1910-0016		DIODE-GE 60 WIV	28480	1910-0016
A8CR3	1910-0016		DIODE-GE 60 WIV	28480	1910-0016
A8CR4	1901-0040		DIODE-SILICON 50 MA 30 WV	07263	FD1008
A8J1	1251-2035	1	CONNECTOR-PC EDGE (2 X 15) 30 CONTACT	71785	252-15-30-300
A8Q1	1854-0092		TSTR-SI NPN	80131	2N3563
A8Q2	1854-0092		TSTR-SI NPN	80131	2N3563
A8Q3	1854-0365		TSTR-SI NPN	80131	2N441C
A8Q4	1854-0365		TSTR-SI NPN	80131	2N441C
A8Q5	1854-0365		TSTR-SI NPN	80131	2N441C
A8Q6	1854-0365		TSTR-SI NPN	80131	2N441C
A8Q7	1854-0365		TSTR-SI NPN	80131	2N441C
A8Q8	1854-0365		TSTR-SI NPN	80131	2N441C
A8Q9	1854-0092		TSTR-SI NPN	80131	2N3563
A8Q10	1854-0092		TSTR-SI NPN	80131	2N3563
A8Q11	1854-0092		TSTR-SI NPN	80131	2N3563
A8R1	0683-1125	1	RESISTOR-FXD COMP 1100 OHM 5% 1/4W	01121	CB 1125
A8R2	0683-1045	5	RESISTOR-FXD COMP 100K OHMS 5% 1/4W	01121	CB 1045
A8R3	0683-1045		RESISTOR-FXD COMP 100K OHMS 5% 1/4W	01121	CB 1045
A8R4	0683-1025		RESISTOR-FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A8R5	0683-1255	6	RESISTOR-FXD COMP 1.2 MEGOHM 5% 1/4W	01121	CB 1255
A8R6	0683-1255		RESISTOR-FXD COMP 1.2 MEGOHM 5% 1/4W	01121	CB 1255
A8R7	0683-1255		RESISTOR-FXD COMP 1.2 MEGOHM 5% 1/4W	01121	CB 1255
A8R8	0683-1255		RESISTOR-FXD COMP 1.2 MEGOHM 5% 1/4W	01121	CB 1255
A8R9	0683-1255		RESISTOR-FXD COMP 1.2 MEGOHM 5% 1/4W	01121	CB 1255
A8R10	0683-1255		RESISTOR-FXD COMP 1.2 MEGOHM 5% 1/4W	01121	CB 1255
A8R11	0683-2425		RESISTOR-FXD COMP 2400 OHM 5% 1/4W	01121	CB 2425
A8R12	0683-1015		RESISTOR-FXD COMP 100 OHM 5% 1/4W	01121	CB 1015
A8R13	0683-1025		RESISTOR-FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A8R14	0683-2715		RESISTOR-FXD COMP 270 OHM 5% 1/4W	01121	CB 2715
A8R15	0683-4725		RESISTOR-FXD COMP 4700 OHM 5% 1/4W	01121	CB 4725
A8R16	0683-1025		RESISTOR-FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A8R17	0683-4725		RESISTOR-FXD COMP 4700 OHM 5% 1/4W	01121	CB 4725
A8R18	0683-5115		RESISTOR-FXD COMP 510 OHM 5% 1/4W	01121	CB 5115
A8R19	0683-1045		RESISTOR-FXD COMP 100K OHMS 5% 1/4W	01121	CB 1045
A8R20	0683-1045		RESISTOR-FXD COMP 100K OHMS 5% 1/4W	01121	CB 1045
A8R21	0683-2725		RESISTOR-FXD COMP 2700 OHM 5% 1/4W	01121	CB 2725
A8R22	0683-5115		RESISTOR-FXD COMP 510 OHM 5% 1/4W	01121	CB 5115
A8R23	0683-1045		RESISTOR-FXD COMP 100K OHMS 5% 1/4W	01121	CB 1045
A8R24	0683-2725		RESISTOR-FXD COMP 2700 OHM 5% 1/4W	01121	CB 2725
A8R25	0683-1535	1	RESISTOR-FXD COMP 15K OHM 5% 1/4W	01121	CB 1535
A8R26	0683-2225		RESISTOR-FXD COMP 2.2K OHM 5% 1/4W	01121	CB 2225
A8U1	1820-0094	1	IC-DTL QUAD 2-INPUT GATE	04713	SC8903PX
A8U2	1820-0307	1	IC-DTL HEX INVERTER	04713	MC836P
A8U3	1820-0143	1	INTEGRATED CIRCUIT-TAC COUPLED JK F/F	04713	MC1027P
A8U4	1820-0102		INTEGRATED CIRCUIT-J-K FLIP FLOP	04713	MC1013P
A8U5	1820-0102		INTEGRATED CIRCUIT-J-K FLIP FLOP	04713	MC1013P
A8U6	1820-0102		INTEGRATED CIRCUIT-J-K FLIP FLOP	04713	MC1013P
A9	05326-60008	1	DISPLAY ASSY (SERIES 1224A) (LOADED ON 05326-20008/25 BLANK BOARD).	28480	05326-60008
A9DS1	1970-0042	15	TUBE-NUMERICAL INDICATOR	83594	B-5750-5
A9DS2	1970-0042		TUBE-NUMERICAL INDICATOR	83594	B-5750-5
A9DS3	1970-0042		TUBE-NUMERICAL INDICATOR	83594	B-5750-5
A9DS4	1970-0042		TUBE-NUMERICAL INDICATOR	83594	B-5750-5
A9DS5	1970-0042		TUBE-NUMERICAL INDICATOR	83594	B-5750-5
A9DS6	1970-0042		TUBE-NUMERICAL INDICATOR	83594	B-5750-5
A9DS7	1970-0042		TUBE-NUMERICAL INDICATOR	83594	B-5750-5
A9R1	0683-1035		RESISTOR-FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A9R2	0698-8431	8	RESISTOR-FLM 7.5K OHM 2% 1/8W	28480	0698-8431
A9R3	0683-1025		RESISTOR-FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025

See introduction to this section for ordering information

Table 6-1. Replaceable Parts (Continued)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A9R4	0698-8431		RESISTOR: FILM 7.5K OHM 2% 1/8W	28480	0698-8431
A9R5	0698-8431		RESISTOR: FILM 7.5K OHM 2% 1/8W	28480	0698-8431
A9R6	0698-8431		RESISTOR: FILM 7.5K OHM 2% 1/8W	28480	0698-8431
A9R7	0698-8431		RESISTOR: FILM 7.5K OHM 2% 1/8W	28480	0698-8431
A9R8	0698-8431		RESISTOR: FILM 7.5K OHM 2% 1/8W	28480	0698-8431
A9R9	0698-8431		RESISTOR: FILM 7.5K OHM 2% 1/8W	28480	0698-8431
A9R10	0683-1005	3	RESISTOR: COMP 10 OHM 5% 1/4W	01121	CB 1005
A9R11	0698-8431		RESISTOR: FILM 7.5K OHM 2% 1/8W	28480	0698-8431
A9R12	0683-1005		RESISTOR: COMP 10 OHM 5% 1/4W	01121	CB 1005
A9U1	1820-0278	2	IC:ECL TO TTL QUAD 2-INPT OR TRANS.	04713	MC1039P
A9U2	1820-0119	15	IC:TTL BLANKING DECADE COUNTER	28480	1820-0119
A9U3	1820-0119		IC:TTL BLANKING DECADE COUNTER	28480	1820-0119
A9U4	1820-0119		IC:TTL BLANKING DECADE COUNTER	28480	1820-0119
A9U5	1820-0119		IC:TTL BLANKING DECADE COUNTER	28480	1820-0119
A9U6	1820-0119		IC:TTL BLANKING DECADE COUNTER	28480	1820-0119
A9U7	1820-0119		IC:TTL BLANKING DECADE COUNTER	28480	1820-0119
A9U9	1820-0116	15	IC:4-BIT BUFF STORE GATED OUTS	28480	1820-0116
A9U10	1820-0116		IC:4-BIT BUFF STORE GATED OUTS	28480	1820-0116
A9U11	1820-0116		IC:4-BIT BUFF STORE GATED OUTS	28480	1820-0116
A9U12	1820-0116		IC:4-BIT BUFF STORE GATED OUTS	28480	1820-0116
A9U13	1820-0116		IC:4-BIT BUFF STORE GATED OUTS	28480	1820-0116
A9U14	1820-0116		IC:4-BIT BUFF STORE GATED OUTS	28480	1820-0116
A9U15	1820-0116		IC:4-BIT BUFF STORE GATED OUTS	28480	1820-0116
A9U17	1820-0729	1	IC:DECODER-DIVIDER	28480	1820-0729
A9U18	1820-0092	14	INTEGRATED CIRCUIT:DECODER-DIVIDER	28480	1820-0092
A9U19	1820-0092		INTEGRATED CIRCUIT:DECODER-DIVIDER	28480	1820-0092
A9U20	1820-0092		INTEGRATED CIRCUIT:DECODER-DIVIDER	28480	1820-0092
A9U21	1820-0092		INTEGRATED CIRCUIT:DECODER-DIVIDER	28480	1820-0092
A9U22	1820-0092		INTEGRATED CIRCUIT:DECODER-DIVIDER	28480	1820-0092
A9U23	1820-0092		INTEGRATED CIRCUIT:DECODER-DIVIDER	28480	1820-0092
A9XU8	1200-0477	6	SOCKET:IC	28480	1200-0477
A9XU16	1200-0477		SOCKET:IC	28480	1200-0477
A9XU24	1200-0477		SOCKET:IC	28480	1200-0477
A9XDS1	1200-0406	16	SOCKET: TUBE, FOR 6700 SERIES	83504	SK207
A9XDS2	1200-0406		SOCKET: TUBE, FOR 6700 SERIES	83504	SK207
A9XDS3	1200-0406		SOCKET: TUBE, FOR 6700 SERIES	83504	SK207
A9XDS4	1200-0406		SOCKET: TUBE, FOR 6700 SERIES	83504	SK207
A9XDS5	1200-0406		SOCKET: TUBE, FOR 6700 SERIES	83504	SK207
A9XDS6	1200-0406		SOCKET: TUBE FOR 6700 SERIES	83504	SK207
A9XDS7	1200-0406		SOCKET: TUBE FOR 6700 SERIES	83504	SK207
A10	05326-60036	1	BOARD ASSY:RIGHT READOUT (SERIES 1036A) (LOADED ON 05326-20036 BLANK BOARD)	28480	05326-60036
	05326-00009	3	BRACKET:READOUT	28480	05326-00009
	05326-80008	1	INDICATOR:MASK (U,N,S,)	28480	05326-80008
	05326-80009	1	INDICATOR:MASK (V,M,HZ)	28480	05326-80009
	05326-80010	1	INDICATOR:MASK (*,K,G)	28480	05326-80010
	05330-40002	5	BLOCK:ANNUNCIATOR	28480	05330-40002
	0510-0207	6	NUT:CAPTIVE 4-40 X 0.188 LG	28480	0510-0207
A10DS1	2140-0313	11	LAMP:NEON GLOW FROSTED 1.9 MILLIAMPS	08806	C2A-B
A10DS2	2140-0313		LAMP:NEON GLOW FROSTED 1.9 MILLIAMPS	08806	C2A-B
A10DS3	2140-0313		LAMP:NEON GLOW FROSTED 1.9 MILLIAMPS	08806	C2A-B
A10DS4	2140-0313		LAMP:NEON GLOW FROSTED 1.9 MILLIAMPS	08806	C2A-B
A10DS5	2140-0313		LAMP:NEON GLOW FROSTED 1.9 MILLIAMPS	08806	C2A-B
A10DS6	2140-0313		LAMP:NEON GLOW FROSTED 1.9 MILLIAMPS	08806	C2A-B
A10DS7	2140-0313		LAMP:NEON GLOW FROSTED 1.9 MILLIAMPS	08806	C2A-B
A10DS8	2140-0313		LAMP:NEON GLOW FROSTED 1.9 MILLIAMPS	08806	C2A-B
A10Q1	1854-0009		TSTR:SI NPN	80131	2N709
A10Q2	1854-0009		TSTR:SI NPN	80131	2N709
A10Q3	1854-0009		TSTR:SI NPN	80131	2N709
A10Q4	1854-0474	12	TSTR:SI NPN	28480	1854-0474
A10Q5	1854-0474		TSTR:SI NPN	28480	1854-0474
A10Q6	1854-0474		TSTR:SI NPN	28480	1854-0474
A10Q7	1854-0474		TSTR:SI NPN	28480	1854-0474
A10Q8	1854-0474		TSTR:SI NPN	28480	1854-0474
A10Q9	1854-0474		TSTR:SI NPN	28480	1854-0474
A10Q10	1854-0474		TSTR:SI NPN	28480	1854-0474
A10Q11	1854-0474		TSTR:SI NPN	28480	1854-0474
A10R1	0683-5125		RESISTOR: COMP 5100 OHM 5% 1/4W	01121	CB 5125
A10R2	0683-5125		RESISTOR: COMP 5100 OHM 5% 1/4W	01121	CB 5125
A10R3	0683-5125		RESISTOR: COMP 5100 OHM 5% 1/4W	01121	CB 5125

Table 6-1. Replaceable Parts (Continued)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A1CR4	0683-3025		FIXED COMP 3000 OHM 5% 1/4W	C1121	CB 3025
A1CR5	0683-2025		FIXED COMP 2000 OHM 5% 1/4W	C1121	CB 2025
A1CR6	0683-2025		FIXED COMP 2000 OHM 5% 1/4W	C1121	CB 2025
A1CR7	0683-3025		FIXED COMP 3000 OHM 5% 1/4W	C1121	CB 3025
A1CR8	0683-5135	5	FIXED COMP 51K OHM 5% 1/4W	C1121	CB 5135
A1CR9	0683-5135		FIXED COMP 51K OHM 5% 1/4W	C1121	CB 5135
A1CU1	1820-0274	9	IC:DTL QUAD 2-INPT OR GATE	28480	1820-0274
A1CU2	1820-0274		IC:DTL QUAD 2-INPT OR GATE	28480	1820-0274
A1CU3	1820-0273	1	IC:DTL QUAD 2-INPT AND GATE	28480	1820-0273
A1CU4	1820-0310	1	IC:DTL TRIPLE 3-INPUT NAND GATE	04713	SG651CPN
A1CU5	1820-0274		IC:DTL QUAD 2-INPT OR GATE	28480	1820-0274
A1CU6	1820-0274		IC:DTL QUAD 2-INPT OR GATE	28480	1820-0274
A11	05326-60035	1	BOARD ASSY:LEFT READOUT (SERIES 1136A) (LOADED ON 05326-2003, BLANK BOARD)	28480	05326-60035
	05326-00009		BRACKET:READOUT	28480	05326-00009
	05326-80011	1	INDICATOR:MASK (EXT, C, DF)	28480	05326-80011
	05330-40002		BLOCK:ANNUNCIATOR	28480	05330-40002
A11C1			NOT ASSIGNED		
A11C2	0160-2930		FIXED CER 0.01 UF +80-20% 100VDCW	51406	TA
A11C3	0140-2200	1	FIXED MICA 43 PF 5%	72136	RDM15E430J3C
A11DS1	2140-0313		LAMP:NEON GLOW FROSTED 1.6 MILLIAMPS	08806	C2A-B
A11DS2	2140-0313		LAMP:NEON GLOW FROSTED 1.6 MILLIAMPS	08806	C2A-B
A11DS3	2140-0313		LAMP:NEON GLOW FROSTED 1.6 MILLIAMPS	08806	C2A-B
A11Q1	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A11Q2	1854-0474		TSTR:SI NPN	28480	1854-0474
A11Q3	1854-0474		TSTR:SI NPN	28480	1854-0474
A11Q4	1854-0474		TSTR:SI NPN	28480	1854-0474
A11R1	0683-1035		FIXED COMP 10K OHM 5% 1/4W	01121	CB 1035
A11R2	0683-2035	2	FIXED COMP 20K OHM 5% 1/4W	01121	CB 2035
A11R3	0683-1025		FIXED COMP 1000 OHM 5% 1/4W	01121	CB 1025
A11R4	0683-1525		FIXED COMP 1500 OHM 5% 1/4W	01121	CB 1525
A11R5	0683-2025		FIXED COMP 2000 OHM 5% 1/4W	01121	CB 2025
A11R6	0683-2025		FIXED COMP 2000 OHM 5% 1/4W	01121	CB 2025
A11R7	0683-2025		FIXED COMP 2000 OHM 5% 1/4W	01121	CB 2025
A11R8	0683-5135		FIXED COMP 51K OHM 5% 1/4W	01121	CB 5135
A11R9	0683-5135		FIXED COMP 51K OHM 5% 1/4W	01121	CB 5135
A11R10	0683-5135		FIXED COMP 51K OHM 5% 1/4W	01121	CB 5135
A11R11	0683-1025		FIXED COMP 1000 OHM 5% 1/4W	01121	CB 1025
A11U1	1820-0175	1	IC:TTL HEX INVERTER,OPEN COLL.	01295	SN7405N
A11U2	1820-0274		IC:DTL QUAD 2-INPT OR GATE	28480	1820-0274
A11U3	1820-0274		IC:DTL QUAD 2-INPT OR GATE	28480	1820-0274
A11U4	1820-0274		IC:DTL QUAD 2-INPT OR GATE	28480	1820-0274
A11U5	1820-0274		IC:DTL QUAD 2-INPT OR GATE	28480	1820-0274
A11U6	1820-0274		IC:DTL QUAD 2-INPT OR GATE	28480	1820-0274
A11U7	1820-0273		IC:DTL QUAD 2-INPT AND GATE	28480	1820-0273
A11U8	1820-0273		IC:DTL QUAD 2-INPT AND GATE	28480	1820-0273
A11U9	1820-0054		IC:TTL QUAD 2-INPT NAND GATE	01295	SN7400N
A12			NOT ASSIGNED		
A13			NOT ASSIGNED		
A14			NOT ASSIGNED		
A15	05327-60020	1	BOARD ASSY:POWER SUPPLY (SERIES 1312A) (LOADED ON 05326-2002D BLANK BOARD)	28480	05327-60020
	0510-0207		NUT:CAPTIVE 4-40 X 0.188 LG	28480	0510-0207
	2200-0145	3	SCREW:PAN HD POZI DR 4-40 X 0.438	00000	ORD
	5040-0409	1	SPACER:SHIELD	28480	5040-0409
A15C1	0160-0163	1	FIXED MY 0.033 UF 10% 200VDCW	56289	192P33392-PTS
A15C2	0180-0114		FIXED ELECT 4.0 UF +100-10% 25VDCW	28480	0180-0114
A15C3	0180-0114		FIXED ELECT 4.0 UF +100-10% 25VDCW	28480	0180-0114
A15C4	0180-0114		FIXED ELECT 4.0 UF +100-10% 25VDCW	28480	0180-0114
A15C5	0180-0114		FIXED ELECT 4.0 UF +100-10% 25VDCW	28480	0180-0114
A15C6	0160-0975	2	FIXED CER 0.001 UF 20% 75VDCW	12574	55M-.001-98
A15C7	0160-0975		FIXED CER 0.001 UF 20% 75VDCW	12574	55M-.001-98

See introduction to this section for ordering information

Table 6-1. Replaceable Parts (Continued)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A15C8	C180-3277	2	C:FXD CER 0.01 UF 20% 50VDCW	96733	G504BX103M
A15C9	C180-3277		C:FXD CER 0.01 UF 20% 50VDCW	96733	G504BX103M
A15CR1	1902-3002	2	DIODE BREAKDOWN:2.37V 5%	28480	1902-3002
A15CR2	1902-0551	2	DIODE BREAKDOWN:6.19V 5%	28480	1902-0551
A15CR3	1902-0551		DIODE BREAKDOWN:6.19V 5%	28480	1902-0551
A15CR4	1902-3002		DIODE BREAKDOWN:2.37V 5%	28480	1902-3002
A15CR5	1901-0046		DIODE:SILICON 50 MA 30 NV	07263	FDG1088
A15CR6	1902-3094	4	DIODE BREAKDOWN:5.11V 2%	28480	1902-3094
A15CR7	1902-3094		DIODE BREAKDOWN:5.11V 2%	28480	1902-3094
A15CR8	1901-0040		DIODE:SILICON 50 MA 30 NV	07263	FDG1088
A15CR9	1902-3094		DIODE BREAKDOWN:5.11V 2%	28480	1902-3094
A15CR10	1902-3094		DIODE BREAKDOWN:5.11V 2%	28480	1902-3094
A15CR11	1902-3394	1	DIODE BREAKDOWN:6.75 V 2%	28480	1902-3394
A15CR12	1902-3429	1	DIODE BREAKDOWN:8.2C V 2%	28480	1902-3429
A15CR13	1901-0033	2	DIODE:SILICON 100MA 180NV	07263	FD3369
A15CR14	1901-0033		DIODE:SILICON 100MA 180NV	07263	FD3369
A15CR15	1901-0044	4	DIODE:SILICON 20MA/1V	28480	1901-0044
A15CR16	1901-0044		DIODE:SILICON 20MA/1V	28480	1901-0044
A15CR17	1901-0044		DIODE:SILICON 20MA/1V	28480	1901-0044
A15CR18	1901-0044		DIODE:SILICON 20MA/1V	28480	1901-0044
A15F1	2110-0460	1	FUSE: 1/32 AMP	28480	2110-0460
A1501	1854-0300	1	TSTR:SI NPN	28480	1854-0300
A1501	1205-0018	2	HEAT SINK:SEMICONDUCTOR	05820	203-CB
A1502	1853-0073	1	TSTR:SI PNP	28480	1853-0073
A1502	1205-0018		HEAT SINK:SEMICONDUCTOR	05820	203-CB
A1503	1854-0039	1	TSTR:SI NPN	80131	2N3053
A1503	1205-0033	2	HEAT SINK:SEMICONDUCTOR	05820	207-CB
A1504	1853-0012	1	TSTR:SI PNP	80131	2N2904A
A1504	1205-0033		HEAT SINK:SEMICONDUCTOR	05820	207-CB
A1505	1854-0232	1	TSTR:SI NPN:SELECTED FROM 2N3440)	28480	1854-0232
A1505	1205-0061	1	HEAT SINK:SEMICONDUCTOR	05820	209-CB
A1506	1853-0020	2	TSTR:SI PNP:SELECTED FROM 2N3702)	28480	1853-0020
A1507	1854-0071		TSTR:SI NPN:SELECTED FROM 2N3704)	28480	1854-0071
A1508	1854-0474		TSTR:SI NPN	28480	1854-0474
A1509	1854-0071		TSTR:SI NPN:SELECTED FROM 2N3704)	28480	1854-0071
A15D10	1853-0020		TSTR:SI PNP:SELECTED FROM 2N3702)	28480	1853-0020
A15F1	0683-2735		:IFXD COMP 27K OHM 5% 1/4W	01121	CB 2735
A15R2	0683-1015		RIFXD COMP 100 OHM 5% 1/4W	01121	CB 1015
A15R3	0683-1015		RIFXD COMP 100 OHM 5% 1/4W	01121	CB 1015
A15R4	0683-3925	3	RIFXD COMP 3900 OHM 5% 1/4W	01121	CB 3925
A15R5	0683-3925		RIFXD COMP 3900 OHM 5% 1/4W	01121	CB 3925
A15R6	0686-1305	1	RIFXD COMP 13 OHM 5% 1/2W	01121	EB 1305
A15R7	0683-6815		RIFXD COMP 680 OHM 5% 1/4W	01121	CB 6815
A15R8	0683-6815		RIFXD COMP 680 OHM 5% 1/4W	01121	CB 6815
A15R9	0683-1325	2	RIFXD COMP 1300 OHM 5% 1/4W	01121	CB 1325
A15R10	2100-2093	2	RIVAR COMP 200 OHM 30% LIN 1/8W	28480	2100-2093
A15R11	0683-6815		RIFXD COMP 680 OHM 5% 1/4W	01121	CB 6815
A15R12	0683-6815		RIFXD COMP 680 OHM 5% 1/4W	01121	CB 6815
A15R13	2100-2093		RIVAR COMP 200 OHM 30% LIN 1/8W	28480	2100-2093
A15R14	0683-1325		RIFXD COMP 1300 OHM 5% 1/4W	01121	CB 1325
A15R15	0683-0275	4	RIFXD COMP 2.7 OHM 5% 1/4W	01121	CB 2705
A15R16	0683-0275		RIFXD COMP 2.7 OHM 5% 1/4W	01121	CB 2705
A15R17	0683-0275		RIFXD COMP 2.7 OHM 5% 1/4W	01121	CB 2705
A15R18	0683-0275		RIFXD COMP 2.7 OHM 5% 1/4W	01121	CB 2705
A16	05327-60028	1	BOARD ASSY:CONNECTOR (SERIES 1224A) (LOADED ON 05327-20028 BLANK BOARD)	28480	05327-60028
A16C1	0180-2352	1	C:FXD ELECT 6000 UF +75-10% 15VDCW	28480	0180-2352
A16C2	0180-2296	1	C:FXD ELECT 4000 UF +75-10% 15VDCW	56289	350D687-U15B(SE)
A16C3	0180-1962	1	C:FXD AL ELECT 15 UF +50-10% 250VDCW	56289	350D56F250EJ4-D5B
A16C4	0180-2382	2	C:FXD ELECT 700 UF +75-10% 30VDCW	28480	0180-2382
A16C5	0180-2382		C:FXD ELECT 700 UF +75-10% 30VDCW	28480	0180-2382
A16C6	C160-2204		C:FXD MICA 1600PF 5%	72136	RDM15F101J3C
A16CR1	1910-0016		DIODE:GE 60 NIV	28480	1910-0016
A16CR2	1910-0016		DIODE:GE 60 NIV	28480	1910-0016
A16CR3	1910-0016		DIODE:GE 60 NIV	28480	1910-0016
A16CR4	1901-0028	2	DIODE:SILICON 0.75A 400PIV	04713	SR1358-9
A16CR5	1901-0028		DIODE:SILICON 0.75A 400PIV	04713	SR1358-9
A16CR6	1901-0029	4	DIODE:SILICON 600 PIV	28480	1901-0029
A16CR7	1901-0029		DIODE:SILICON 600 PIV	28480	1901-0029
A16CR8	1901-0029		DIODE:SILICON 600 PIV	28480	1901-0029

See introduction to this section for ordering information

Table 6-1. Replaceable Parts (Continued)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A16CR9	1901-0029		DIODE:SILICON 600 PIV	28480	1901-0029
A16CR10	1901-0415	4	DIODE:SILICON 50 PIV 3A	28480	1901-0415
A16CR11	1901-0415		DIODE:SILICON 50 PIV 3A	28480	1901-0415
A16CR12	1901-0415		DIODE:SILICON 50 PIV 3A	28480	1901-0415
A16CR13	1901-0415		DIODE:SILICON 50 PIV 3A	28480	1901-0415
A16CR14 THRU			NOT ASSIGNED		
A16CR17			NOT ASSIGNED		
A16CR18	1910-0034	1	DIODE:GERMANIUM 25V	28480	1910-0034
A16P1	5060-0115	1	CONNECTOR ASSY:15 CONTACT	28480	5060-0115
A16Q1	1854-0009		TSTR:SI NPN	80131	2N709
A16P1	0812-0021	1	RIFXD WW 0.47 OHM 5% 3W	28480	0812-0021
A16R2	0811-1732	1	RIFXD WW 1 OHM 5% 3W	28480	0811-1732
A16P3	0686-2045	1	RIFXD COMP 200K OHM 5% .5W	01121	EB 2045
A16P4	0683-8225	1	RIFXD COMP 8.2 OHM 5% 1/4W	01121	CB 8225
A16R5	0683-1025		RIFXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A16P6	0683-5115		RIFXD COMP 510 OHM 5% 1/4W	01121	CB 5115
A16R7	0698-3153	1	RIFXD MET FLM 3.83K OHM 1% 1/8W	28480	0698-3153
A16P8	0757-0439	1	RIFXD MET FLM 6.81K OHM 1% 1/8W	28480	0757-0439
A16U1	1820-0196	1	IC:LINEAR VOLTAGE REGULATOR(INPUT)	28480	1820-0196
A16XA1			NOT ASSIGNED		
A16XA2	1251-1886	6	CONN:PC 30-CONTACT (2X15)	71785	252-15-30-340
A16XA3			NOT ASSIGNED		
A16XA4	1251-1886		CONN:PC 30-CONTACT (2X15)	71785	252-15-30-340
A16XA5	1251-1886		CONN:PC 30-CONTACT (2X15)	71785	252-15-30-340
A16XA6	1251-2134	4	CONNECTOR:PC (2X18)36 CONTACTS	71785	252-18-30-340
A16XA7	1251-2134		CONNECTOR:PC (2X18)36 CONTACTS	71785	252-18-30-340
A16XA8	1251-1886		CONN:PC 30-CONTACT (2X15)	71785	252-15-30-340
A16XA9			NOT ASSIGNED		
A16XA10	1251-2134		CONNECTOR:PC (2X18)36 CONTACTS	71785	252-18-30-340
A16XA11	1251-2134		CONNECTOR:PC (2X18)36 CONTACTS	71785	252-18-30-340
A16XA12			NOT ASSIGNED		
A16XA13			NOT ASSIGNED		
A16XA14			NOT ASSIGNED		
A16XA15	1251-1886		CONN:PC 30-CONTACT (2X15)	71785	252-15-30-340
A16XA16			NOT ASSIGNED		
A16XA17			NOT ASSIGNED		
A16XA18	1251-1886		CONN:PC 30-CONTACT (2X15)	71785	252-15-30-340
	1400-0776	1	CLAMP:CABLE 4.0" DIA	28480	1400-0776
A17			NOT ASSIGNED		
A18	05327-60033	1	BOARD ASSY:HIGH SENSITIVITY PRESCALER (SERIES 2648A) (LOADED ASSY 05327-20033 BLANK BOARD).	28480	05327-60033
A18C1	0180-0228		CAPXD ELECT 22 UF 10% 15VDCW	56289	150D226X9015B2-DYS
A18C2	0160-2049	2	CAPXD CER FEED-THRU 5000 PF +80-20%	28480	0160-2049
A18C3	0160-3879	3	CAPXD CER 0.01 UF 20% 100VDCW	72982	8121-8112-X7R-103M
A18C4	0160-2049		CAPXD CER FEED-THRU 5000 PF +80-20%	28480	0160-2049
A18C5	0180-0228		CAPXD ELECT 22 UF 10% 15VDCW	56289	150D226X9015B2-DYS
A18C6	0160-3879		CAPXD CER 0.01 UF 20% 100VDCW	72982	8121-8112-X7R-103M
A18C7 THRU					
A18C27	0160-3878	21	CAPXD CER 1000 PF 20% 100VDCW	80031	CV2059X7R102M
A18C28	0160-3879		CAPXD CER 0.01 UF 20% 100VDCW	72982	8121-8112-X7R-103M
A18C29	0160-3878		CAPXD CER 1000 PF 20% 100VDCW	80031	CV2059X7R102M
A18CR1	1901-0050	2	DIODE:SI 200 MA AT 1V	07263	FDA 6308
A18CR2	1901-0050		DIODE:SI 200 MA AT 1V	07263	FDA 6308
A18CR3	1901-0040		DIODE:SILICON 50 MA 30 MV	07263	FDG1088
A18CR4	1901-0040		DIODE:SILICON 50 MA 30 MV	07263	FDG1088
A18CR5	1901-0040		DIODE:SILICON 50 MA 30 MV	07263	FDG1088
A18CR6	1901-0040		DIODE:SILICON 50 MA 30 MV	07263	FDG1088
A18F1	2110-0436	2	FUSE:1/10 AMP 125V	28480	2110-0436
A18F2	2110-0436		FUSE:1/10 AMP 125V (SPARE)	28480	2110-0436
A18J1	1250-0836	1	CONNECTOR:RF SUB-MINIATURE	58291	SC-053-0000
A18L1	9100-1788	2	COIL:CHOKE	02114	VK200-10/4B
A18L2	9100-1788		COIL:CHOKE	02114	VK200-10/4B
A18Q1	1854-0345		TSTR:SI NPN	80131	2N5175
A18Q2	1854-0092		TSTR:SI NPN	80131	2N3563
A18R1	0683-1025		RIFXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A18R2	0698-5996	2	RIFXD COMP 360 OHM 5% 1/8W	28480	0698-5996
A18R3	2100-2633	1	RIVAR CERMET 1K OHM 10% LIN 1/2W	28480	2100-2633
A18R4	0683-3925		RIFXD COMP 3900 OHM 5% 1/4W	01121	CB 3925

See introduction to this section for ordering information

Table 6-1. Replaceable Parts (Continued)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A18P5	0698-3378	5	RESD CARBON 51 OHM 5% 1/8W	28480	0698-3378
A18R6	0698-3378		RESD CARBON 51 OHM 5% 1/8W	28480	0698-3378
A18R7	0698-3111	5	RESD COMP 30 OHM 5% 1/8W	28480	0698-3111
A18R8	0683-1025		RESD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A18R9	0683-2015		RESD COMP 200 OHM 5% 1/4W	01121	CB 2015
A18R10	2100-2413	2	RESVAR FLM 200 OHM 10% LIN 1/2W	28480	2100-2413
A18R11	0698-6283	2	RESD COMP 10 OHM 5% 1/8W	01121	BB 1005
A18R12	0683-1505	2	RESD COMP 15 OHM 5% 1/4W	01121	CB 1505
A18R13	0698-3374	4	RESD CARBON 20 OHM 5% 1/8W	28480	0698-3374
A18P14			NOT ASSIGNED		
A18R15	0698-5180		RESD COMP 2K OHM 5% 1/8W	28480	0698-5180
A18R16	0698-3378		RESD CARBON 51 OHM 5% 1/8W	28480	0698-3378
A18R17	0698-3374		RESD CARBON 20 OHM 5% 1/8W	28480	0698-3374
A18R18	0683-4315		RESD COMP 430 OHM 5% 1/4W	01121	CB 4315
A18R19	0698-5180		RESD COMP 2K OHM 5% 1/8W	28480	0698-5180
A18P20	0698-3111		RESD COMP 30 OHM 5% 1/8W	28480	0698-3111
A18R21	0698-5996		RESD COMP 560 OHM 5% 1/8W	28480	0698-5596
A18R22	0698-4131	4	RESD COMP 56 OHM 5% 1/8W	28480	0698-4131
A18R23	0698-4131		RESD COMP 56 OHM 5% 1/8W	28480	0698-4131
A18R24	0698-3111		RESD COMP 30 OHM 5% 1/8W	28480	0698-3111
A18R25	0683-1025		RESD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A18R26	0683-1015		RESD COMP 100 OHM 5% 1/4W FACTORY SELECT	01121	CB 1015
A18R27	2100-2413		RESVAR FLM 200 OHM 10% LIN 1/2W	28480	2100-2413
A18R28	0698-6283		RESD COMP 10 OHM 5% 1/8W	01121	BB 1005
A18R29	0698-8177	2	RESD COMP 820 OHM 5% 1/8W	28480	0698-8177
A18P30	0698-5103		RESD COMP 430 OHM 5% 1/8W	28480	0698-5103
A18R31	0683-1505		RESD COMP 15 OHM 5% 1/4W	01121	CB 1505
A18R32			NOT ASSIGNED		
A18R33	0698-3374		RESD CARBON 20 OHM 5% 1/8W	28480	0698-3374
A18R34	0698-8073	1	RESD COMP 1600 OHM 5% 1/8W	28480	0698-8073
A18P35	0698-3378		RESD CARBON 51 OHM 5% 1/8W	28480	0698-3378
A18P36	0698-3111		RESD COMP 30 OHM 5% 1/8W	28480	0698-3111
A18R37	0698-3378		RESD CARBON 51 OHM 5% 1/8W	28480	0698-3378
A18R38	0698-3374		RESD CARBON 20 OHM 5% 1/8W	28480	0698-3374
A18R39	0683-4315		RESD COMP 430 OHM 5% 1/4W	01121	CB 4315
A18R40	0698-4131		RESD COMP 56 OHM 5% 1/8W	28480	0698-4131
A18R41	0698-5563	1	RESD CARBON 180 OHM 5% 1/8W	28480	0698-5563
A18R42	0698-4131		RESD COMP 56 OHM 5% 1/8W	28480	0698-4131
A18R43	0698-3111		RESD COMP 30 OHM 5% 1/8W	28480	0698-3111
A18R44	0698-3113		RESD CARBON 100 OHM 5% 1/8W	28480	0698-3113
A18R45			NOT ASSIGNED		
A18R46	0683-1025		RESD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A18R47	0683-3905	1	RESD COMP 39 OHM 5% 1/4W	01121	CB 3905
A18R48	0683-8215	1	RESD COMP 820 OHM 5% 1/4W	01121	CB 8215
A18R49	0683-1025		RESD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A18R50	0683-4315		RESD COMP 430 OHM 5% 1/4W	01121	CB 4315
A18R51	0683-4315		RESD COMP 430 OHM 5% 1/4W	01121	CB 4315
A18R52	0683-4315		RESD COMP 430 OHM 5% 1/4W	01121	CB 4315
A18R53			NOT ASSIGNED		
A18U1	5086-7602	1	IC:LIMITER	28480	5086-7602
A18U2	1826-0084	1	IC:LINEAR	28480	1826-0084
A18U3	1826-0085	1	IC:LINEAR	28480	1826-0085
A18U4	1820-0736	1	IC:DIGITAL	28480	1820-0736
A18U4OR	1820-0558	1	IC:DUAL-BINARY	28480	1820-0558
A18U5	1820-0714	1	IC:DIGITAL QUINARY DIVIDER	28480	1820-0714
A18U6	1820-0489		IC:ECL	28480	1820-0489
A18U7	1221-CC01	2	TRANSISTOR ARRAY:SI NPN	02735	CA3046
A18U8	1821-CC01		TRANSISTOR ARRAY:SI NPN	02735	CA3046
A18U9	1820-0862	1	IC:ECL, QUAD 2-INPT NOR GATE	04713	MC10102L
			CHASSIS PARTS		
B1	3140-0030	1	MOTOR:SHADED POLE	28480	3140-0030
B1	3150-0039	1	FILTER:AIR	28480	3150-0039
B1	3160-0035	1	FAN:IMPELLER AXIAL 2-1/4 DIAM	04870	Z 1/4 MHF 125 S
B1	5212A-128	1	BRACKET:FAN	28480	5212A-128
C1	0160-3043	1	CER:FXD CER 2 X 0.005 UF 20% 250VAC	56289	29C147A-CDH
F1	2110-0020	1	FUSE:0.8A 250V SLOW-BLOW	75915	313.8005
F1	2110-0304	1	FUSE:CARTRIDGE 1.5 AMP 250V SLOW-BLOW	71400	MDX-1-1/2A
F1	1400-0084	1	FUSEHOLDER:EXTRACTOR POST TYPE	75915	342014
J4	1250-1253	3	CONNECTOR:RF BNC MOUNT JACK	24931	28JR194-1
J5	1250-1253		CONNECTOR:RF BNC MOUNT JACK	24931	28JR194-1
J6	1250-1253		CONNECTOR:RF BNC MOUNT JACK	24931	28JR194-1
J7			PART OF 05327-60011 PRESCALER CABLE ASS		
J8	1251-7357	1	SOCKET:3-PIN MALE POWER RECEPTACLE	82389	EAC-301
J11	1250-0212	1	CONNECTOR:JACK CHASSIS BNC	95712	30409-1
Q1	1853-0233	1	TSTR:SI PNP	01295	TIP 32

See introduction to this section for ordering information

Table 6-1. Replaceable Parts (Continued)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
Q1	05327-20024	2	HEAT SINK FOR Q1 AND Q2	28480	05327-20024
Q2	1854-0420	1	TSTR:SI NPN	28480	1854-0420
R1	2100-2961	1	KVAR COMP 1 MEGOHM 10% 10 CLOG 1/4W	28480	2100-2961
R2	00180-67403	2	RHEOSTAT ASSY	28480	00180-67403
S1			PART OF A1		
S2	3101-1327	2	SWITCH:SLIDE DPDT 0.5A 125V AC/DC (FAST-NORM-HOLD)	79727	G1285-0006
S3	3101-1216	1	SWITCH:PUSH-BUTTON (5PST) (RESET)	82389	85-1034
S4	3101-1327		SWITCH:SLIDE DPDT 0.5A 125V AC/DC (5327C-INPUT SELECT)	79727	G1285-0006
S5	05326-60018	1	SWITCH ASSY:TIME BASE(W REG)	28480	05326-60018
S9	0370-0104	2	KNOB:BLK BAR W/ARROW 1/4W SHAFT (TIME BASE)	28480	0370-0104
S6	05327-60030	1	SWITCH ASSY:FUNCTION	28480	05326-60038
S6	0370-0104		KNOB:BLK BAR W/ARROW 1/4W SHAFT (FUNCTION)	28480	0370-0104
S7	3101-1311		SWITCH:SLIDE DPDT 0.5A 125V AC/DC (OSC-INT/EXT)	79727	G126-0020
S8	3101-1311		SWITCH:SLIDE DPDT 0.5A 125V AC/DC (STORAGE)	79727	G126-0020
S9	3101-1234	1	SWITCH:SLIDE DPDT (SELECTOR 115/230V)	82389	11A-1742
T1	9100-3020	1	TRANSFORMER:POWER	28480	9100-3020
	1200-0147	1	BUSHING:TRANSISTOR	28480	1200-0147
	0340-0766	2	INSULATOR:TRANSISTOR	28480	0340-0766
			OTHER CABINET PARTS		
	0460-0114	1	TAPE:FOL,URETHANE 1-3/4 IN WIDE (FOR TOP COVER)	85471	TECHCELL-2
	1490-0030	1	STAND:TILT	28480	1490-0030
	7120-1254	1	TRADEMARK (HP LOGO)	28480	7120-1254
	5000-0050	2	TRIM:SIDES	28480	5000-0050
	5060-0729	2	FRAME ASSY:3 R (LESSICE)	28480	5060-0729
	5060-0767	5	FOOT ASSY:FM	28480	5060-0767
	01821-67401		A2C:TRIGGER LEVEL (LEVEL)	28480	01821-67401
	05326-00032	1	PANEL:REAR	28480	05327-00032
	05326-00038	1	INSULATOR (FOR BOTTOM COVER)	28480	05326-00038
	05326-00011	2	PLATE:CONNECTOR,LONG (J9 & J10 COVER)	28480	05326-00011
	05326-00014	1	PANEL:REAR	28480	05326-00014
	05326-20029	1	WINDOW (5326C)	28480	05326-20029
	05327-20001	1	WINDOW (5327C)	28480	05327-20001
			PAINTED CABINET PARTS		
	05326-00027	1	LEFT FRONT PANEL TRIM(5326C)	28480	05326-00027
	05326-00028		RIGHT FRONT PANEL TRIM	28480	05326-00028
	05326-00029	2	SIDE COVER	28480	05326-00029
	05326-00030	1	TOP COVER	28480	05326-00030
	05326-60046	1	KIT:RACK MOUNT	28480	05326-60046
			CONSISTING OF: 2370-0012 6-32 X .250 LG. (3) 2510-0047 8-32 X .438 LG (4) 5020-7619 LEFT BRACKET (1) 5020-7620 RIGHT BRACKET (1) 05326-40003 FILLER STRIP (1)		
	05327-00010	1	LEFT FRONT PANEL TRIM(5327C)	28480	05327-00010
	05330-00033	1	BOTTOM COVER	28480	05330-00033

See introduction to this section for ordering information

Table 6-1. Replaceable Parts (Continued)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
			INTERNAL AND OTHER PARTS		
	8120-1378	1	CABLE ASSY:AC POWER CORD	70903	BH-7081
	5040-0170	1	GUIDE:PLUG-IN PC BOARD (A15 BOARD SUPPORT)	28480	5040-0170
	5060-0109	1	CONNECTOR:15 CONTACTS	28480	5060-0109
	05326-00010	1	SHIELD:INSIDE	28480	05326-00010
	05326-00018	1	CHASSIS	28480	05326-00018
	05326-20046	1	BOARD:BLANK (REAR PANEL INTERCONNECT)	28480	05326-20046
	05327-60037	1	CABLE ASSY:PRESCALER	28480	05327-60037
			OPTION 001 8 DIGIT DISPLAY) DELETE A9 05326-60008 AND REPLACE WITH A9 05326-60025.		
A9	05326-60025	1	DISPLAY ASSY (SERIES 1224A) (LOADED ON 05326-20008/26 BLANK BOARD)	28480	05326-60025
A9DS1	1970-0042		TUBE:NUMERICAL INDICATOR	83594	B-5750-5
A9DS2	1970-0042		TUBE:NUMERICAL INDICATOR	83594	B-5750-5
A9DS3	1970-0042		TUBE:NUMERICAL INDICATOR	83594	B-5750-5
A9DS4	1970-0042		TUBE:NUMERICAL INDICATOR	83594	B-5750-5
A9DS5	1970-0042		TUBE:NUMERICAL INDICATOR	83594	B-5750-5
A9DS6	1970-0042		TUBE:NUMERICAL INDICATOR	83594	B-5750-5
A9DS7	1970-0042		TUBE:NUMERICAL INDICATOR	83594	B-5750-5
A9DS8	1970-0042		TUBE:NUMERICAL INDICATOR	83594	B-5750-5
A9R1	0683-1025		R: FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A9R2	0757-0945	6	R: FXD FLM 7500 OHM 2% 1/4W	28480	0757-0945
A9R3	0683-1025		R: FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A9R4	0757-0945		R: FXD FLM 7500 OHM 2% 1/4W	28480	0757-0945
A9R5	0757-0945		R: FXD FLM 7500 OHM 2% 1/4W	28480	0757-0945
A9R6	0757-0945		R: FXD FLM 7500 OHM 2% 1/4W	28480	0757-0945
A9R7	0757-0945		R: FXD FLM 7500 OHM 2% 1/4W	28480	0757-0945
A9R8	0757-0945		R: FXD FLM 7500 OHM 2% 1/4W	28480	0757-0945
A9R9	0757-0945		R: FXD FLM 7500 OHM 2% 1/4W	28480	0757-0945
A9R10			NOT ASSIGNED		
A9R11	0757-0945		R: FXD FLM 7500 OHM 2% 1/4W	28480	0757-0945
A9R12	0683-1005		R:FXD COMP 10 OHM 5% 1/4W	01121	CB 1005
A9U1	1820-0275		IC:ECL TO TTL QUAD 2-INPT OR TRANS.	04713	MC1035P
A9U2	1820-0119		IC:TTL BLANKING DECADE COUNTER	28480	1820-0119
A9U3	1820-0119		IC:TTL BLANKING DECADE COUNTER	28480	1820-0119
A9U4	1820-0119		IC:TTL BLANKING DECADE COUNTER	28480	1820-0119
A9U5	1820-0119		IC:TTL BLANKING DECADE COUNTER	28480	1820-0119
A9U6	1820-0119		IC:TTL BLANKING DECADE COUNTER	28480	1820-0119
A9U7	1820-0119		IC:TTL BLANKING DECADE COUNTER	28480	1820-0119
A9U8	1820-0119		IC:TTL BLANKING DECADE COUNTER	28480	1820-0119
A9U9	1820-0116		IC:4-BIT BUFF STORE GATED OUTS	28480	1820-0116
A9U10	1820-0116		IC:4-BIT BUFF STORE GATED OUTS	28480	1820-0116
A9U11	1820-0116		IC:4-BIT BUFF STORE GATED OUTS	28480	1820-0116
A9U12	1820-0116		IC:4-BIT BUFF STORE GATED OUTS	28480	1820-0116
A9U13	1820-0116		IC:4-BIT BUFF STORE GATED OUTS	28480	1820-0116
A9U14	1820-0116		IC:4-BIT BUFF STORE GATED OUTS	28480	1820-0116
A9U15	1820-0116		IC:4-BIT BUFF STORE GATED OUTS	28480	1820-0116
A9U16	1820-0116		IC:4-BIT BUFF STORE GATED OUTS	28480	1820-0116
A9U17	1820-0729		INTEGRATED CIRCUIT:DECODER-DIVIDER	28480	1820-0729
A9U18	1820-0092		INTEGRATED CIRCUIT:DECODER-DIVIDER	28480	1820-0092
A9U19	1820-0092		INTEGRATED CIRCUIT:DECODER-DIVIDER	28480	1820-0092
A9U20	1820-0092		INTEGRATED CIRCUIT:DECODER-DIVIDER	28480	1820-0092
A9U21	1820-0092		INTEGRATED CIRCUIT:DECODER-DIVIDER	28480	1820-0092
A9U22	1820-0092		INTEGRATED CIRCUIT:DECODER-DIVIDER	28480	1820-0092
A9U23	1820-0092		INTEGRATED CIRCUIT:DECODER-DIVIDER	28480	1820-0092

See Introduction to this section for ordering information

Table 6-1. Replaceable Parts (Continued)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A9U4	1820-0092		INTEGRATED CIRCUIT:DECODER-DRIVER	28480	1820-0092
A9XU51	1200-0405		SOCKET:TUBE FOR 5700 SERIES	83594	SK 207
A9XU52	1200-0405		SOCKET:TUBE FOR 5700 SERIES	83594	SK 207
A9XU53	1200-0405		SOCKET:TUBE FOR 5700 SERIES	83594	SK 207
A9XU54	1200-0405		SOCKET:TUBE FOR 5700 SERIES	83594	SK 207
A9XU55	1200-0405		SOCKET:TUBE FOR 5700 SERIES	83594	SK 207
A9XU56	1200-0405		SOCKET:TUBE FOR 5700 SERIES	83594	SK 207
A9XU57	1200-0405		SOCKET:TUBE FOR 5700 SERIES	83594	SK 207
A9XU58	1200-0405		SOCKET:TUBE FOR 5700 SERIES	83594	SK 207
A9XU8	1200-0477		SOCKET:IC	28480	1200-0477
A9XU16	1200-0477		SOCKET:IC	28480	1200-0477
A9XU24	1200-0477		SOCKET:IC	28480	1200-0477
			OPTION 002 (REMOTE PROGRAMMING) DELETE 5060-0109 15 CONTACT CONNECTOR AND ADD 06327-60013 CABLE ASSY		
	06327-60013	1	CABLE ASSY: PROGRAMMING CONSISTING OF:	28480	06327-60013
J10	1251-0086	1	CONNECTOR: FEMALE 36-PIN MINAT	28480	1251-0086
W2P1	5060-0113	1	CONNECTOR: 45 CONTACT	28480	5060-0113
W2P2	1200-0063	1	LUG: CRIMP	28480	1200-0063
	06326-00033	1	ADAPTER: CONN	28480	06326-00033
			OPTION 003 (DIGITAL OUTPUT) ADD 06326-60012 CABLE ASSY		
J9	1251-0087	1	CONNECTOR: FEMALE 50-PIN MINAT	28480	1251-0087
W1P1	1251-2262	2	CONNECTOR: PC (2 X 10) 20 CONTACTS	76530	251-10-30-400
W1P2	1251-2262		CONNECTOR: PC (2 X 10) 20 CONTACTS	76530	251-10-30-400
			OPTION 010 (HIGH-STABILITY OSCILLATOR) DELETE A4 OSCILLATOR ASSY (06326-60002) AND ADD 06327-60056 OPT 010. (LOADED ON 06327-20036 BLANK BOARD)		
	0960-0318		TCXO	28480	0960-0318
			OPTION 011 (HIGH-STABILITY OSCILLATOR) DELETE A4 OSCILLATOR ASSY (06326-60002) AND ADD 10644-60011, OPT 011.		

See introduction to this section for ordering information

Table 6-2. Manufacturers Code List

MFR NO.	MANUFACTURER NAME	ADDRESS	ZIP CODE
	NO M/F DESCRIPTION FOR THIS MFG NUMBER		
00000	NO M/F DESCRIPTION FOR THIS MFG NUMBER		
00000	U.S.A. COMMON	ANY SUPPLIER OF U.S.A.	
01121	ALLEN BRADLEY CO.	MILWAUKEE, WIS.	53204
01295	TEXAS INSTRUMENTS INC. SEMICONDUCTOR COMPONENTS DIV.	DALLAS, TEX.	75231
02114	FERROXCUBE CORP.	SAUGERTIES, N.Y.	12477
02735	RCA SOLID STATE & RECEIVING TUBE DIV.	SOMERVILLE, N.J.	08876
04713	MOTOROLA SEMICONDUCTOR PROD.INC.	PHOENIX ARIZ.	85008
04870	P M MOTOR CO.	WESTCHESTER, ILL.	60154
05820	WAKEFIELD ENGINEERING INC.	WAKEFIELD, MASS.	01880
07263	FAIRCHILD CAMERA & INST. CORP. SEMICONDUCTOR DIV.	MOUNTAIN VIEW, CALIF.	94040
08806	G.E. CO. MINIATURE LAMP DEPT.	CLEVELAND, OHIO	44112
12040	NATIONAL SEMICONDUCTOR CORP.	DANBURY, CONN.	06810
12574	GULTON IND. INC. DATA SYSTEM DIV.	ALBUQUERQUE, N.M.	87108
14655	CORNELL DUBLIER ELECT. DIV.FEDERAL PACIFIC ELECT. CO.	NEWARK, N.J.	07105
17856	SILICONIX INC.	SUNNYVALE, CALIF.	94086
24931	SPECIALTY CONNECTOR CO. INC.	INDIANAPOLIS, IND.	46227
28480	HEWLETT-PACKARD CO. CORPORATE HQ	YOUR NEAREST HP OFFICE	
56289	SPRAGUE ELECTRIC CO.	N. ADAMS, MASS.	01247
70903	BELDEN CORP.	CHICAGO, ILL.	60644
71400	BUSSMANN MFG. DIV. MC GRAW-EDISON CO.	ST. LOUIS, MO.	63017
71785	CINCH MFG. CO. DIV TRW INC.	ELK GROVE VILLAGE, ILL.	
72136	ELECTRO MOTIVE MFG. CO. INC.	WILLIMANTIC, CONN.	06226
72982	ERIE TECHNOLOGICAL PROD. INC.	ERIE, PA.	16512
75915	LITTELFUSE INC.	DES PLAINES, ILL.	60016
79727	CONTINENTAL-WIRT ELECTRONICS CORP.	WARMINSTER, PA.	18974
80031	MEPCO DIV. SESSIONS CLOCK CO.	MORRISTOWN, N.J.	07960
80131	ELECTRONIC INDUSTRIES ASSOCIATION	WASHINGTON D.C.	20006
82142	AIRCO SPEER ELECT. COMP.	DU BOIS, PA.	15801
82389	SWITCHCRAFT INC.	CHICAGO, ILL.	60630
83594	BURROUGHS CORP. ELECT. COMP. DIV.	PLAINSFIELD, N.J.	07061
85471	BOYD A.B. CO.	SAN FRANCISCO,CALIF.	94103
91418	RADIO MATERIALS CO.	CHICAGO, ILL.	60646
95712	BENDIX CORP. THE MICROWAVE DEVICE DIV.	FRANKLIN, IND.	46131
96733	SAN FERNANDO ELECT. MFG. CO.	SAN FERNANDO, CALIF.	91341
98291	SEALECTRO CORP.	MAMARONECK, N.Y.	10544

SECTION VII

OPTIONS AND MANUAL CHANGES

7-1. INTRODUCTION

7-2. This section contains information necessary to adapt this manual to older instruments. Also included is the operating and installation information for available options. Refer to Section II for remote programming requirements.

7-3. MANUAL CHANGES

7-4. This manual applies directly to Model 5326C and Model 5327C having serial prefix 1312A (refer to Paragraph 1-4).

7-5. Newer Instruments

7-6. As changes are made, newer instruments may have serial prefixes that are not listed in this manual. The manuals for these instruments are supplied with a manual change sheet, containing the required information. Contact the nearest Hewlett-Packard Sales and Service Office for information if this sheet is missing.

7-7. Older Instruments

7-8. To adapt this manual to instruments having a serial prefix prior to 1312A for the 5326C or the 5327C, perform the backdating that applies to your instrument's serial prefix, as listed in the table below.

Serial Prefix		Perform Change
5326C	5327C	
	1236A	11
1224A		10
	1224A	11, 10
1204A		10, 9
	1220A	11, 10, 9
1140A		10, 9, 8
	1136A	11, 10, 9
1136A		10, 9, 8, 7
	1124A	11, 10, 9, 8, 7, 6, 5, 3
1120A		10, 9, 8, 7, 6, 5, 4, 1
	1040A	11, 10, 9, 8, 7, 6, 5, 3, 2, 1
1036A		10, 9, 8, 7, 6, 5, 4, 2, 1

CHANGE 1

Page 6-7, Table 6-1:
Delete A7R24 from parts list.

Page 8-25, Figure 8-10:
Delete A7R24 from schematic and component locator.
Change series number on A7 schematic to read 1040A, Rev. B.

CHANGE 2

Page 6-7, Table 6-1:
Delete A7R23 from parts list.

Page 6-10, Table 6-1:
Replace A15 parts list with Table 7-1.

Page 6-14, Table 6-1:
Change part numbers to read:
COVER-SIDE 3 x 11 ..... 5000-0729, 2 ea.
COVER-TOP ..... 05326-00008, 1 ea.
INSULATOR (Q1 & Q2) ..... 0340-0162, 2 ea.
(Replaces Heat Sink)

Page 8-25, Figure 8-10:
Delete A7R23 from schematic and component locator.
Change series number on A7 schematic to read 1036A, Rev. A.

Page 8-35, Figure 8-15:
Replace A15 schematic with Figure 7-1.
Replace A15 component locator with Figure 7-2.

CHANGE 3

Page 6-11, Table 6-1:
Change A16 Bd. Assy. Connector P/N to read 05327-60014, series number 1040A.

Page 8-35, Figure 8-15:
Change A16 Bd. Assy. Connector P/N (top of schematic) to read 05327-60014, series number 1040A.

CHANGE 4

Page 6-11, Table 6-1:
Change A16 Bd. Assy. Connector P/N to read 05326-60037, series number 1036A.

Page 8-35, Figure 8-15:
Change A16 Bd. Assy. Connector P/N (top of schematic) to read 05326-60037, series number 1036A.

CHANGE 5

Page 6-10, Table 6-1:
Replace A1 parts list with Table 7-2.

Page 8-33, Figure 8-14:
Replace A11 schematic with Figure 7-3.
Replace A11 component locator with Figure 7-4.

CHANGE 6

Page 6-6, Table 6-1:
Change A6R19 to read 0683-2025, 2000 ohms 5% ¼W, Mfr. P/N is CB 2025. A6 series number is 1036A.

Page 6-7, Table 6-1:
Change A7C1 to read 0160-2198, 20 pF, 300 VDCW
Change A7C2 to read 0160-0333, 15 pF, 300 VDCW
Change A7R10 to read 0683-2025, 2000 ohms 5% ¼W, Mfr. P/N is CB 2025. A7 series number is 1120A.

Page 8-21, Figure 8-9:
Change value of A6R19 to 2000 ohms.
Change series number (top of schematic) to read 1036A.

Page 8-25, Figure 3-10:
Change value of A7C1 to 20 pF.
Change value of A7C2 to 15 pF.
Change value of A7R10 to 2000 ohms.
Change series number (top of schematic) to read 1120A.

CHANGE 7

Page 6-14, Table 6-1:
Change T1 9100-3020 to 9100-2888

CHANGE 8

Page 6-11, Table 6-1:
Delete A15C8 part number and description.
Change A15R17 and R18 to 0683-0395, 3.9 ohms, Mfr. P/N is CB 39G5. Series number of board is now 1040A (page 6-10).

Page 8-35, Table 6-1:
Delete A15C8 from schematic.
Change value of A15R17 and A15R18 to 3.9 ohms.
Change A15 series number (top of schematic) to read 1040A.

CHANGE 9

Page 6-3, Table 6-1:
Change A1 05326-60048 to 05326-60030.
Change A1 blank board number to 05326-20030.
Change A1R12 2100-3228 to 2100-2905. Series number is now 1036A.

Page 6-14, Table 6-1:
Change 05326-00032 (rear panel) to read 05326-00004.
Change quantity of 05326-60011 to 1 ea. and description to "Plate:Connector, Long (J9 cover)."
Add "05326-60012 Plate:Connector, Short (J10 cover)."

Page 6-15, Table 6-1:
Change 05326-20046 Blank Board part number to 05326-20028.

Page 6-16, Table 6-1:
Delete part number and description of 05326-30033 Adapter.

Page 8-15, Figure 8-6:
Change A1 part number (top of schematic) to 05326-60030, Series 1036A.

CHANGE 10

Page 6-8, Table 6-1:
Change A9 series number to 1032A.
Change blank board number to 05326-20008.

Page 6-9, Table 6-1:
Delete the following parts:
A9R11, A9R12, A9XDS8, A9XU8, A9XU16, and A9XU24.

Pages 6-11 and 12, Table 6-1:
Change A16 series number to 1132A.
Delete the following parts:
A16C6, A16CR18, A16Q1, A16R4 through A16R8, and A16U1.

Pages 6-15 and 16, Table 6-1:
Change A9 (Option 001) series number to 1032A.
Change blank board number to 05326-20025.
Add A9R10 0683-1005, 10 ohms, 5%, ¼W.
Delete the following parts:
A9R12, A9XU8, A9XU16, and A9XU24.

Page 6-16, Table 6-1:
Delete all reference to Option 010 and Option 011.

Page 7-21, Paragraph 7-23:
Add the following parts:
0683-7525, 7560Ω, 5%, ¼W
1200-0405 Display Tube Socket
Replace Step c. with the following statement:
"R10 carries the overflow information from the decades and can be placed in one of two positions. Move R10 to position B, as shown in the component locator. In this location, R10 connects to pin. 8 of U8. Replace boards in instrument." The component locator mentioned above is found in Section VII.

Page 8-29, Figure 8-12:
Replace A9 schematic with Figure 7-5.
Replace A9 component locator with Figure 7-6.

Page 8-39, Figure 8-17:
Delete Option 010 and 011 schematic and component locator.

CHANGE 11

Page 1-3, Table 1-3:
Change Range specifications to read:
Direct: 1 kHz to 50 MHz.
Prescaled: 0 to 550 MHz.
Change Sensitivity specifications to read:
Direct: 5 mV rms.
Prescaled: 100 mV rms.

Page 6-16, Table 6-1:
Replace A18 parts list with either Table 7-3 for A18 05327-60009 or Table 7-4 for A18 05327-60029. Both assemblies perform the same function, and either assembly may be supplied with the instrument.

Page 8-37, Figure 8-16:
Replace A18 schematic and component locator with either Figures 7-7 and 7-8 for A18 05327-60009 or Figures 7-9 and 7-10 for A18 05327-60029. Both assemblies perform the same function, and either assembly may be supplied with the instrument.
Add Figure 7-11 — A19 schematic, component locator, and parts list.
Add Figure 7-12 and Table 7-4.

Table 7-1. A15 Replaceable Parts Lists

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A15	05328-60001	1	REGULATOR ASSY	28480	05328-60001
	05328-20001		BOARD BLANK		
A15C1	0160-0163	1	CAPACITOR-FXD MY 0.033 UF 10% 200VDCW	56289	192P33392-PT5
A15C2	0180-0114		CAPACITOR-FXD ELECT 4.0 UF +100-10% 25VDCW	28480	0180-0114
A15C3	0180-0114		CAPACITOR-FXD ELECT 4.0 UF +100-10% 25VDCW	28480	0180-0114
A15C4	0180-0114		CAPACITOR-FXD ELECT 4.0 UF +100-10% 25VDCW	28480	0180-0114
A15C5	0180-0114		CAPACITOR-FXD ELECT 4.0 UF +100-10% 25VDCW	28480	0180-0114
A15C6	0160-0975	2	CAPACITOR-FXD CER 0.001 UF 20% 75VDCW	12954	SSM-,001-98
A15C7	0160-0975		CAPACITOR-FXD CER 0.001 UF 20% 75VDCW	12954	SSM-,001-98
A15CR1	1902-3002	2	DIODE-BREAKDOWN:2.37V 5%	28480	1902-3002
A15CR2	1902-0551	2	DIODE-BREAKDOWN:6.19V 5%	28480	1902-0551
A15CR3	1902-0551		DIODE-BREAKDOWN:6.19V 5%	28480	1902-0551
A15CR4	1902-3002		DIODE-BREAKDOWN:2.37V 5%	28480	1902-3002
A15CR5	1901-0040		DIODE-SILICON 30MA 30WV	07263	FDG1088
A15CR6	1902-3094	4	DIODE-BREAKDOWN:5.11V 2%	28480	1902-3094
A15CR7	1902-3094		DIODE-BREAKDOWN:5.11V 2%	28480	1902-3094
A15CR8	1901-0040		DIODE-SILICON 30MA 30WV	07263	FDG1088
A15CR9	1902-3094		DIODE-BREAKDOWN:5.11V 2%	28480	1902-3094
A15CR10	1902-3094		DIODE-BREAKDOWN:5.11V 2%	28480	1902-3094
A15CR11	1902-3394	1	DIODE-BREAKDOWN:75 V 2%	28480	1902-3429
A15CR12	1902-3429	1	DIODE-BREAKDOWN:100 V 2%	71400	GMW 3/10
A15F1	2110-0331	2	FUSE:0.3A	71400	GMW 3/10
A15F2	2110-0331		FUSE:0.3A		
	1251-1636	4	SOCKET-CONNECTOR FOR F1 and F2	80131	2N3053
A1501	1854-0039	2	TSTR:SI NPN	80131	2N2904A
A1502	1853-0012	2	TSTR:SI PNP		
A1503	1854-0039		TSTR:SI NPN	80131	2N3053
A1504	1853-0012		TSTR:SI PNP	80131	2N2904A
A1505	1854-0232	1	TSTR:SI NPN(SELECTED FROM 2N3440)	28480	1854-0232
	1205-0033	4	HEAT SINK FOR Q1, Q2, Q3, Q4		
	1205-0061	1	HEAT SINK FOR Q6		
A1506	1853-0020	2	TSTR:SI PNP(SELECTED FROM 2N3702)	28480	1853-0020
A1507	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A1508	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A1509	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A1510	1853-0020		TSTR:SI PNP(SELECTED FROM 2N3702)	28480	1853-0020
A15R1	0683-2035		RES:FXD COMP 20K OHM 5% 1/4W	01121	CB 2035
A15R2	0683-1015		RES:FXD COMP 100 OHM 5% 1/4W	01121	CB 1015
A15R3	0683-1015		RES:FXD COMP 100 OHM 5% 1/4W	01121	CB 1015
A15R4	0683-3925	2	RES:FXD COMP 3900 OHM 5% 1/4W	01121	CB 3925
A15R5	0683-3925		RES:FXD COMP 3900 OHM 5% 1/4W	01121	CB 3925
A15R6	0683-1505	1	RES:FXD COMP 15 OHM 5% 1/4W	01121	CB 1505
A15R7	0683-1025		RES:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A15R8	0683-1025		RES:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A15R9	0683-1325	2	RES:FXD COMP 1300 OHM 5% 1/4W	01121	CB 1325
A15R10	2100-2093	2	RES:VAR COMP 200 OHM 30% LIN 1/8W	28480	2100-2093
A15R11	0683-6815		RES:FXD COMP 680 OHM 5% 1/4W	01121	CB 6815
A15R12	0683-6815		RES:FXD COMP 680 OHM 5% 1/4W	01121	CB 6815
A15R13	2100-2093		RES:VAR COMP 200 OHM 30% LIN 1/8W	28480	2100-2093
A15R14	0683-1325		RES:FXD COMP 1300 OHM 5% 1/4W	01121	CB 1325

Table 7-2. A11 Parts List

A11	05326-60035	1	BOARD ASSY: LEFT READOUT (Series 1136A)	28480	05326-60035
A11	05326-00009		BRACKET:READOUT	28480	05326-00009
A11	05326-80011	1	INDICATOR: MASK (EXT,C,OF)	28480	05326-80011
A11	05330-40002		BLOCK: ANNUNCIATOR	28480	05330-40002
A11C1			NOT ASSIGNED		
A11C2	0160-2930	1	C:FXD CER 0.01 UF +80-20% 100VDCW	91418	TA
A11C3	0160-2200	1	C:FXD MICA 43 PF 5%	72136	RDM15E430J3C
A11DS1	2140-0313		LAMP : NEON GLOW FROSTED 1.9 MILLIAMPS	08806	C2A-B
A11DS2	2140-0313		LAMP:NEON GLOW FROSTED 1.9 MILLIAMPS	08806	C2A-B
A11DS3	2140-0313		LAMP:NEON GLOW FROSTED 1.9 MILLIAMPS	08806	C2A-B
A11Q1	1854-0071		TSTR:SI NPN (SELECTED FROM 2N3704)	28480	1854-0071
A11Q2	1854-0474		TSTR:SI NPN		
A11Q3	1854-0474		TSTR:SI NPN	28480	1854-0474
A11Q4	1854-0474		TSTR:SI NPN	28480	1854-0474
A11R1	0683-1035		R:FXD COMP 10K OHM 5% ¼W	01121	CB1035
A11R2	0683-2035	2	R:FXD COMP 20K OHM 5% ¼W	01121	CB 2035
A11R3	0683-1025		R:FXD COMP 1000 OHM 5% ¼W	01121	CB 1025
A11R4	0683-1525		R:FXD COMP 1500 OHM 5% ¼W	01121	CB 1525
A11R5	0683-2025		R:FXD COMP 2000 OHM 5% ¼W	01121	CB 2025
A11R6	0683-2025		R:FXD COMP 2000 OHM 5% ¼W	01121	CB 2025
A11R7	0683-2025		R:FXD COMP 2000 OHM 5% ¼W	01121	CB 2025
A11R8	0683-5135		R:FXD COMP 51K OHM 5% ¼W	01121	CB 5135
A11R9	0683-5135		R:FXD COMP 51K OHM 5% ¼W	01121	CB 5135
A11R10	0683-5135		R:FXD COMP 51K OHM 5% ¼W	01121	CB 5135
A11R11	0683-1025		R:FXD COMP 1000 OHM 5% ¼W	01121	CB 1025
A11U1	1820-0175		IC: TTL HEX CONVERTER	01295	SN8200
A11U2	1820-0274		INTEGRATED CIRCUIT:DIGITAL	04713	MC 1808P
A11U3	1820-0274		INTEGRATED CIRCUIT:DIGITAL	04713	MC 1808P
A11U4	1820-0274		INTEGRATED CIRCUIT:DIGITAL	04713	MC 1808P
A11U5	1820-0274		INTEGRATED CIRCUIT:DIGITAL	04713	MC1808P
A11U6	1820-0274		INTEGRATED CIRCUIT: DIGITAL	04713	MC1808P
A11U7	1820-0273	1	IC: DIGITAL	04713	MC1806P
A11U8	1820-0273		INTEGRATED CIRCUIT: DIGITAL	04713	MC1806P
A11U9	1820-0054		IC: TTL QUAD 2-INPUT NAND GATE	01295	SN7400

Table 7-3. A18 Parts List (05327-60009)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A18	05327-60009	1	PRESCALER ASSY (SERIES 1040A) (LOADED ON 05327-20009 BLANK BOARD)	28480	05327-60009
	3050-0067	2	WASHER:FLAT, BAKELITE	00000	OBD
A18C1	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	1500225X9020A2-DYS
A18C2	0160-0975		C:FXD CER 0.001 UF 20% 75VDCW	12574	5SM-.001-98
A18C3	0180-0106		C:FXD ELECT 40 UF 20% 6VDCW	28480	0180-0106
A18C4	0160-0975		C:FXD CER 0.001 UF 20% 75VDCW	12574	5SM-.001-98
A18C5	0180-0106		C:FXD ELECT 40 UF 20% 6VDCW	28480	0180-0106
A18C7	0160-0975		C:FXD CER 0.001 UF 20% 75VDCW	12574	5SM-.001-98
A18C8	0140-0225	2	C:FXD MICA 300 PF 1%	28480	0140-0225
A18C9	0160-0975		C:FXD CER 0.001 UF 20% 75VDCW	12574	5SM-.001-98
A18C10	0160-0975		C:FXD CER 0.001 UF 20% 75VDCW	12574	5SM-.001-98
A18C11	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	1500225X9020A2-DYS
A18C12	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	1500225X9020A2-DYS
A18C13	0160-2049	4	C:FXD CER FEED-THRU 5000 PF +80-20%	28480	0160-2049
A18C14	0160-2049		C:FXD CER FEED-THRU 5000 PF +80-20%	28480	0160-2049
A18CR1	1902-3002		DIODE BREAKDOWN:2.37V 5%	28480	1902-3002
A18CR2	1912-0007		DIODE:TUNNEL EIA TYPE 1N3714	03508	1N3714 SPEC
A18CR3	1902-3048	2	DIODE BREAKDOWN:SILICON 3.48V 5%	28480	1902-3048
A18J1	1250-0836		CONNECTOR:RF SUB-MINIATURE	98291	50-053-0000
A18L2	9100-2251	2	COIL:FXD RF 0.22 UH 10%	28480	9100-2251
A18Q1	1853-0015		TSTR:SI PNP	80131	2N3640
A18Q2	1854-0092		TSTR:SI NPN	80131	2N3563
A18Q3	1854-0092		TSTR:SI NPN	80131	2N3563
A18R1	2100-2633		R:VAR CERMET 1K OHM 10% LIN 1/2W	28480	2100-2633
A18R2	2100-2521		R:VAR FLM 2000 OHM 10% LIN 1/2W	28480	2100-2521
A18R3	0683-5105		R:FXD COMP 51 OHM 5% 1/4W	01121	CB 5105
A18R4	0683-5105		R:FXD COMP 51 OHM 5% 1/4W	01121	CB 5105
A18R5	0683-1045		R:FXD COMP 100K OHMS 5% 1/4W	01121	CB 1045
A18R6	0683-1025		R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A18R7	0698-3378		R:FXD CARBON 51 OHM 5% 1/8W	28480	0698-3378
A18R8	0683-1815		R:FXD COMP 180 OHM 5% 1/4W	01121	CB 1815
A18R9	0683-1825		R:FXD COMP 1800 OHM 5% 1/4W	01121	CB 1825
A18R10	0683-2215		R:FXD COMP 220 OHM 5% 1/4W	01121	CB 2215
A18R11	0683-1825		R:FXD COMP 1800 OHM 5% 1/4W	01121	CB 1825
A18R12	0683-1825		R:FXD COMP 1800 OHM 5% 1/4W	01121	CB 1825
A18R13	0683-1825		R:FXD COMP 1800 OHM 5% 1/4W	01121	CB 1825
A18R14	0683-2015		R:FXD COMP 200 OHM 5% 1/4W	01121	CB 2015
A18R15	0683-2015		R:FXD COMP 200 OHM 5% 1/4W	01121	CB 2015
A18R16	0683-1025		R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A18R17	0683-1515	2	R:FXD COMP 150 OHM 5% 1/4W	01121	CB 1515
A18R18	0683-4315		R:FXD COMP 430 OHM 5% 1/4W	01121	CB 4315
A18R19	0683-3315		R:FXD COMP 330 OHM 5% 1/4W	01121	CB 3315
A18R20	0683-8205	2	R:FXD COMP 82 OHM 5% 1/4W	01121	CB 8205
A18R21	0683-1015		R:FXD COMP 100 OHM 5% 1/4W	01121	CB 1015
A18R22	0683-2025		R:FXD COMP 2000 OHM 5% 1/4W	01121	CB 2025
A18R23	0683-3315		R:FXD COMP 330 OHM 5% 1/4W	01121	CB 3315
A18R24	0683-2405		R:FXD COMP 24 OHM 5% 1/4W	01121	CB 2405
A18U1	5088-7002		IC:LIMITER	28480	5088-7002
A18U2	5086-7089		IC:AMP AND TRIG	28480	5086-7089
A18U3	1820-0736		IC:DIGITAL	28480	1820-0736
A18U4	1820-0714	1	IC:DIGITAL QUINARY DIVIDER	28480	1820-0714
A18U5	1820-0489		IC:ECL	28480	1820-0489
A18U6	1820-0147		IC:ECL TRIPLE 3-INPT NOR GATE	04713	MC1007P
A18U7	1858-0004		TSTR ARRAY:SI NPN DUAL DIFF. AMPL.	28480	1858-0004
A18XU2	1251-1586	45	CONNECTOR:SINGLE CONTACT	00779	2-330808-6

Table 7-4. A18 Parts List (05327-60029)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A18	05327-60029	1	BOARD ASSY:PRESCALER (SERIES 1116A) (LOADED ON 05327-20029 BLANK BOARD)	28480	05327-60029
A18C1	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A18C2	0160-0971		C:FXD CER 0.001 UF 20% 75VDCW	12574	SSM-.001-98
A18C3	0180-0106	4	C:FXD ELECT 60 UF 20% 6VDCW	28480	0180-0106
A18C4	0160-0971		C:FXD CER 0.001 UF 20% 75VDCW	12574	SSM-.001-98
A18C5	0180-0106		C:FXD ELECT 60 UF 20% 6VDCW	28480	0180-0106
A18C6	0160-0971		C:FXD CER 0.001 UF 20% 75VDCW	12574	SSM-.001-98
A18C7	0160-0971		C:FXD CER 0.001 UF 20% 75VDCW	12574	SSM-.001-98
A18C8	0140-0225		C:FXD MICA 300 PF 1%	28480	0140-0225
A18C9	0160-0971		C:FXD CER 0.001 UF 20% 75VDCW	12574	SSM-.001-98
A18C10	0160-0971		C:FXD CER 0.001 UF 20% 75VDCW	12574	SSM-.001-98
A18C11	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A18C12	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A18C13	0160-2049		C:FXD CER FEED-THRU 5000 PF +80-20%	28480	0160-2049
A18C14	0160-2049		C:FXD CER FEED-THRU 5000 PF +80-20%	28480	0160-2049
A18CR1	1902-3002		DIODE:BREAKDOWN:2.37V 5%	28480	1902-3002
A18CR2	1912-0007	2	DIODE:TUNNEL EIA TYPE 1N3714	03508	1N3714 SPE
A18CR3	1902-3048		DIODE BREAKDOWN:SILICON 3.48V 5%	28480	1902-3048
A18J1	1250-0816	2	CONNECTOR:RF SUB-MINIATURE	98291	50-051-0000
A18L1	9140-0138		COIL:FXD RF 1 UH 10%	99800	1025-20
A18L2	9100-2251		COIL:FXD RF 0.22 UH 10%	28480	9100-2251
A18Q1	1853-0015		TSTR:SI PNP	80131	2N1640
A18Q2	1854-0345		TSTR:SI NPN	80131	2N5179
A18Q3	1854-0192		TSTR:SI NPN	80131	2N3563
A18R1	2100-2633	2	R:VAR CERMET 1K OHM 10% LIN 1/2W	28480	2100-2633
A18R2	2100-2521		R:VAR FLM 2000 OHM 10% LIN 1/2W	28480	2100-2521
A18R3	0683-5105		R:FXD COMP 51 OHM 5% 1/4W	01121	CB 5105
A18R4	0683-5105		R:FXD COMP 51 OHM 5% 1/4W	01121	CB 5105
A18R5	0683-1045		R:FXD COMP 100K OHMS 5% 1/4W	01121	CB 1045
A18R6	0683-1025		R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A18R7	0698-3378	2	R:FXD CARBON 51 OHM 5% 1/8W	28480	0698-3378
A18R8	0683-1815	2	R:FXD COMP 180 OHM 5% 1/4W	01121	CB 1815
A18R9	0683-1825	8	R:FXD COMP 1800 OHM 5% 1/4W	01121	CB 1825
A18R10	0683-2215		R:FXD COMP 220 OHM 5% 1/4W	01121	CB 2215
A18R11	0683-1825		R:FXD COMP 1800 OHM 5% 1/4W	01121	CB 1825
A18R12	0683-1825		R:FXD COMP 1800 OHM 5% 1/4W	01121	CB 1825
A18R13	0683-1825		R:FXD COMP 1800 OHM 5% 1/4W	01121	CB 1825
A18R14	0683-2015		R:FXD COMP 200 OHM 5% 1/4W	01121	CB 2015
A18R15	0683-2015		R:FXD COMP 200 OHM 5% 1/4W	01121	CB 2015
A18R16	0683-1025		R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A18R17	0683-1515		R:FXD COMP 150 OHM 5% 1/4W	01121	CB 1515
A18R18	0683-4315		R:FXD COMP 430 OHM 5% 1/4W	01121	CB 4315
A18R19	0683-5115		R:FXD COMP 510 OHM 5% 1/4W	01121	CB 5115
A18R20	0683-8205		R:FXD COMP 82 OHM 5% 1/4W	01121	CB 8205
A18R21	0683-1015		R:FXD COMP 100 OHM 5% 1/4W	01121	CB 1015
A18R22	0683-2025		R:FXD COMP 2000 OHM 5% 1/4W	01121	CB 2025
A18R23	0683-3315		R:FXD COMP 330 OHM 5% 1/4W	01121	CB 3315
A18R24	0683-2405		R:FXD COMP 24 OHM 5% 1/4W	01121	CB 2405
A18R25	0698-3374	1	R:FXD CARBON 20 OHM 5% 1/8W	28480	0698-3374
A18R26	0683-3615	1	R:FXD COMP 360 OHM 5% 1/4W	01121	CB 3615
A18R27	0683-2715		R:FXD COMP 270 OHM 5% 1/4W	01121	CB 2715
A18R28	2100-2670	1	R:VAR CERMET 20 OHM 30% LIN 1/2W	28480	2100-2670
A18U1	5088-7002	2	IC:LIMITER	28480	5088-7002
A18U2	5086-7069	2	IC:AMP AND TRIG	28480	5086-7069
A18U3	1820-0736	2	IC:DIGITAL	28480	1820-0736
A18U4	1820-0784	1	IC:BINARY-QUINARY	28480	1820-0784
A18U5	1820-0489		IC:ECL	28480	1820-0489
A18U6	1820-0147		IC:ECL TRIPLE 3-INPT NOR GATE	04713	MC1007P
A18U7	1858-0004	2	TSTR ARRAY:SI NPN DUAL DIFF. AMPL.	28480	1858-0004
A18U8	1820-0790	1	IC:DIGITAL	28480	1820-0790
A18XU2	1251-1556		CONNECTOR:SINGLE CONTACT	00779	2-330808-8
A18XU4	1251-1556		CONNECTOR:SINGLE CONTACT	00779	2-330808-8
A18XU6	1205-0243	1	HEAT DISSIPATOR	28480	1205-0243
A18XU6	1205-0244	1	RETAINER	28480	1205-0244
A18XU6	0520-0129	2	SCREW:PAN HD POZI DR 2-56 X 0.312" LG	00000	OBD
A18XU6	0610-0001	2	NUT:HEX 2-56 X 0.188"	00000	OBD
	3050-0062		WASHER:FLAT, BAKELITE	00000	OBD
	3050-0079	2	WASHER:NYLON 0.1875" OD	00000	OBD

Table 7-5. A18 Theory (05327-60009)

A18 PRESCALER OPERATION

The prescaler board serves as a direct amplifier-trigger or as a divide-by-ten amplifier-trigger, with the function controlled by the front-panel INPUT SELECTOR switch. With the switch in the PRESCALE position, the circuit performs as follows:

The signal is fed into the 50 Ω input, of J1. U1 limits the input level to about +1 V and provides protection up to 3.5 V rms. There is about 2 dB loss through U1. The signal is passed to U2 amplifier Schmitt Trigger, which is biased for sensitivity by R1. The Schmitt Trigger threshold is about 70 mV and triggers independently of frequency. The square wave from U2(11) is divided by two and again by five in U3 and U4, respectively. Q2 translates the signal to ECL levels, before presenting it to the data switch.

At the same time, U2 amplifier is supplying the direct triggering network with the input signal. C1 ac couples the signal and eliminates the effect of U2 amplifier drift. U7 consists of a dual-differential amplifier, which converts the input voltage to an output current which is driven through tunnel diode CR2. The diode performs a Schmitt Trigger function and squares the output. R2 is used to vary the bias current through CR2 to control the sensitivity. Q1, Q3, C8, and R38 differentiate the signal and pass the negative pulses at an ECL level to U5 data switch.

The data switch is controlled by the INPUT SELECTOR switch (TTL high at U5(2) = Direct; TTL low at U5(2) = Prescale) and connects either the direct or prescaler signal to A7 Function Control by way of the one-shot, U6. The one-shot output goes high (U6(4)) when the input goes low. The output goes low again after about 12 ns when the level changes have propagated through the gates in a domino effect.

A18 TROUBLESHOOTING

Check for operation by placing the INPUT SELECTOR switch in both B and B ÷ 10 positions. If the counter does not work with the switch in either position, the trouble is probably in U1, U2, U5, or U6. In the direct mode, start by checking in the tunnel diode (CR2) area; check for proper waveforms of 5 and 6. For the prescale mode, start by checking the output of divide-by-two circuit, U3(6).

Figure 7-1. A15 Schematic

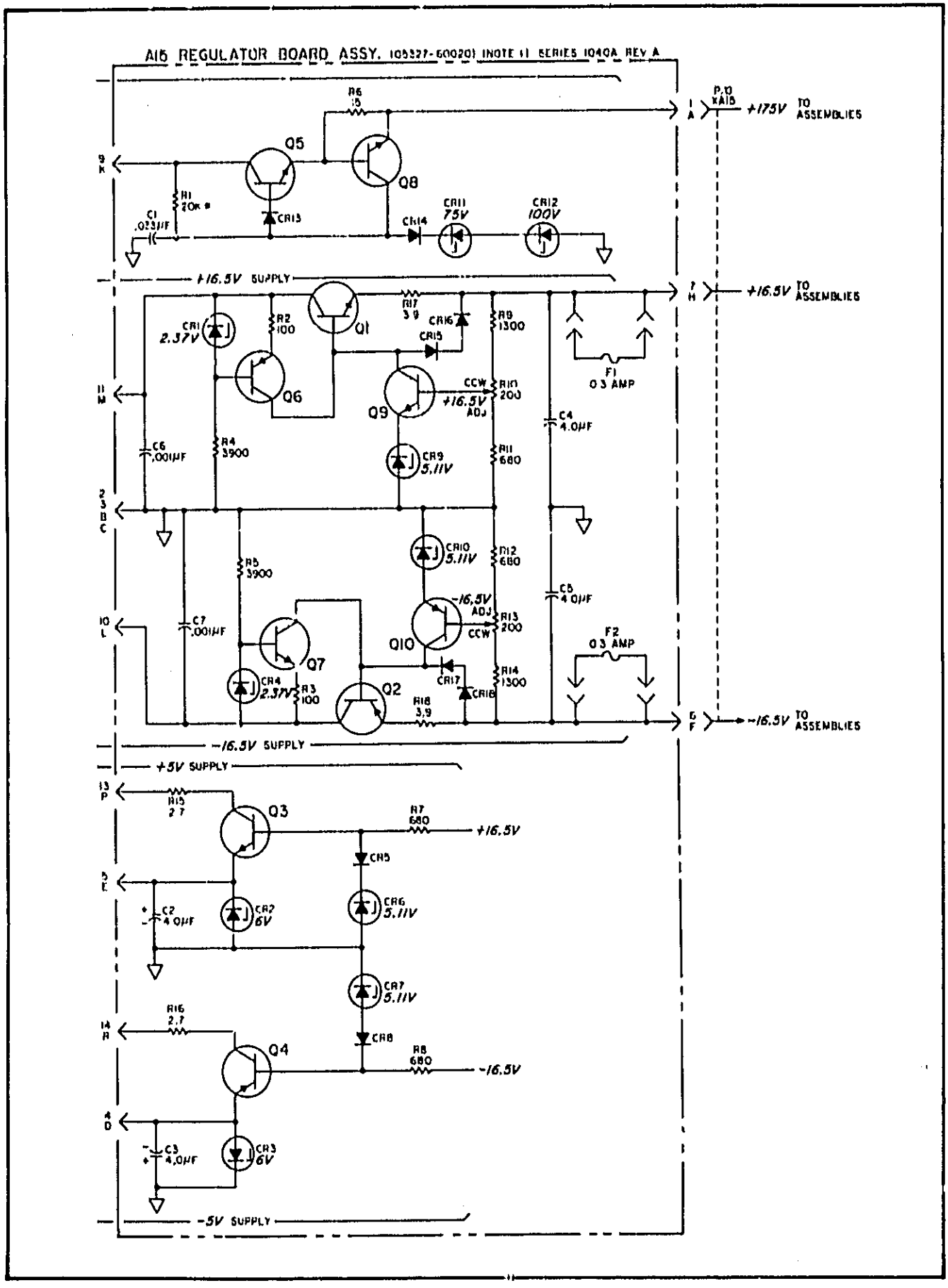


Figure 7-2. A15 Component Locator

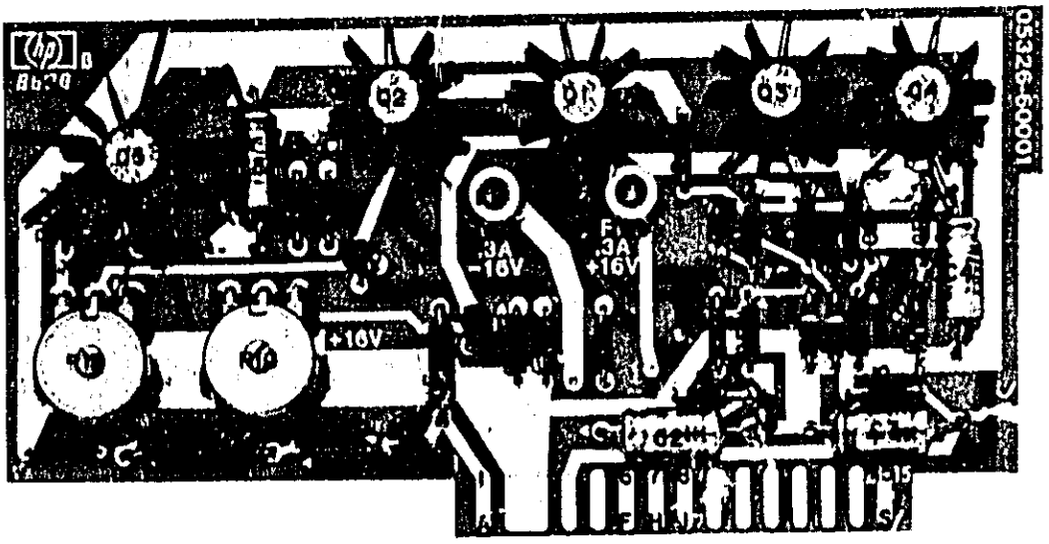


Figure 7-3. A11 Schematic

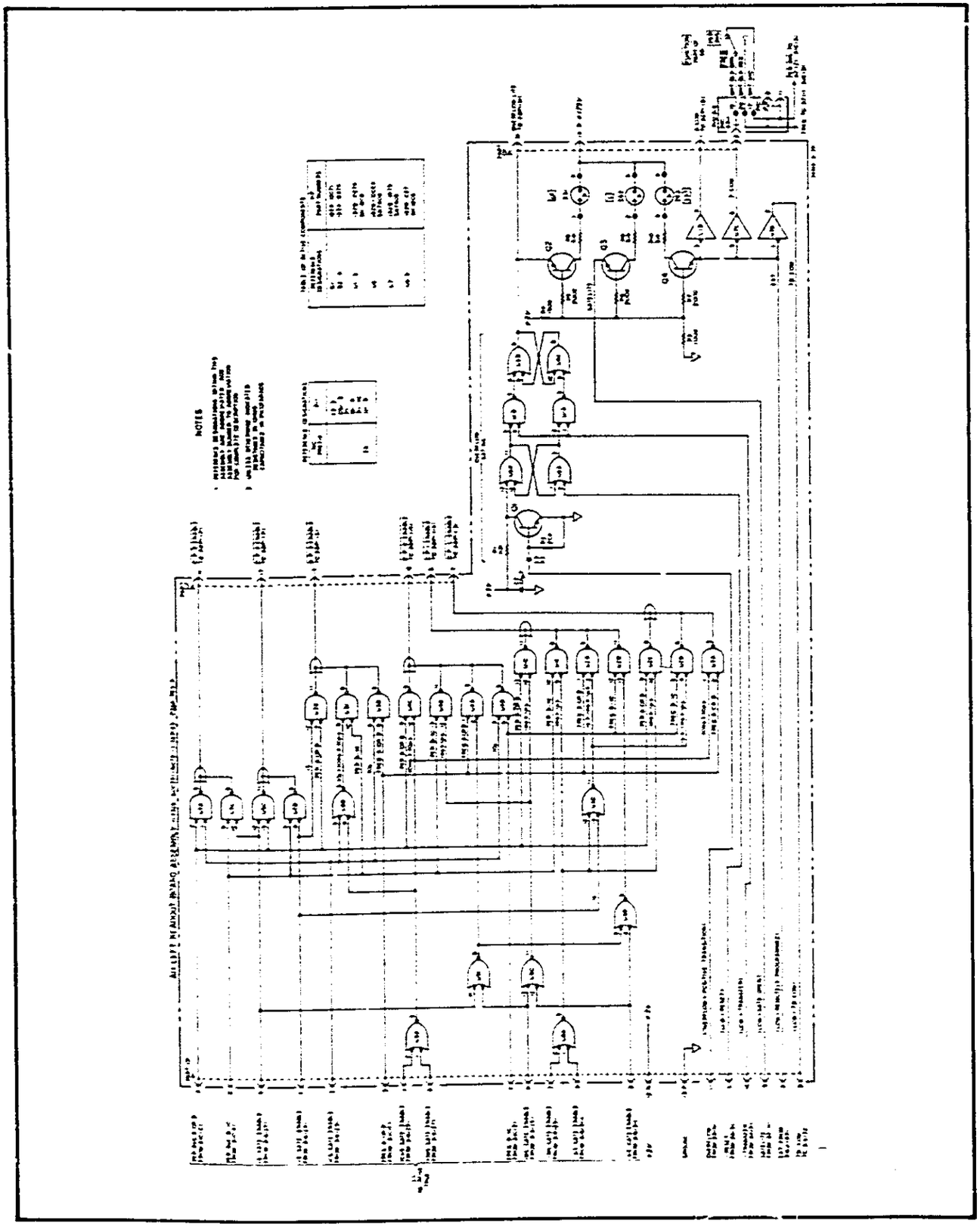


Figure 7-4. A11 Component Locator

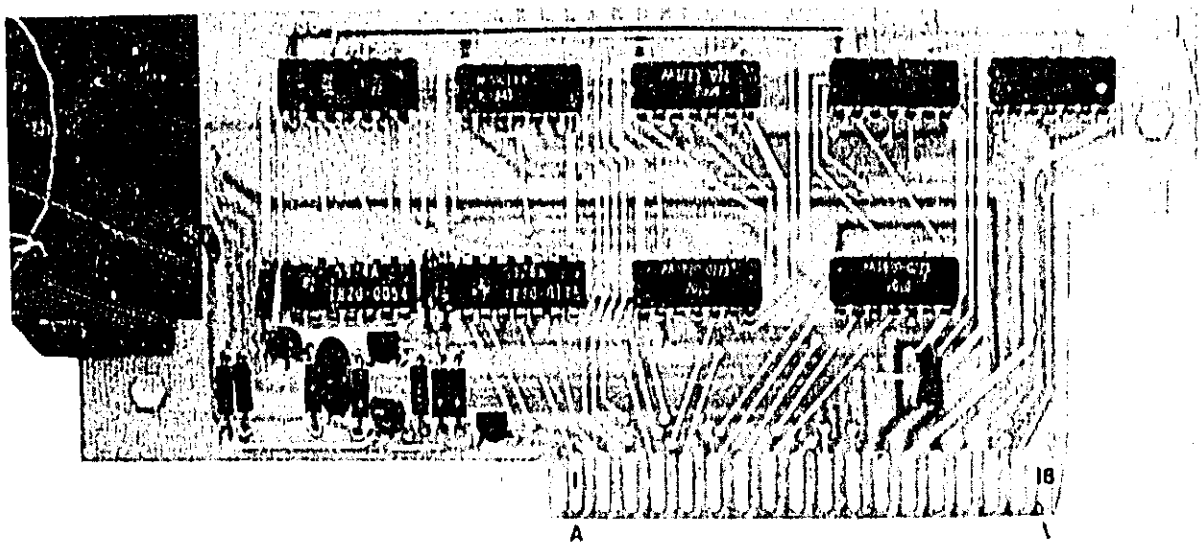


Figure 7-5. A9 Schematic

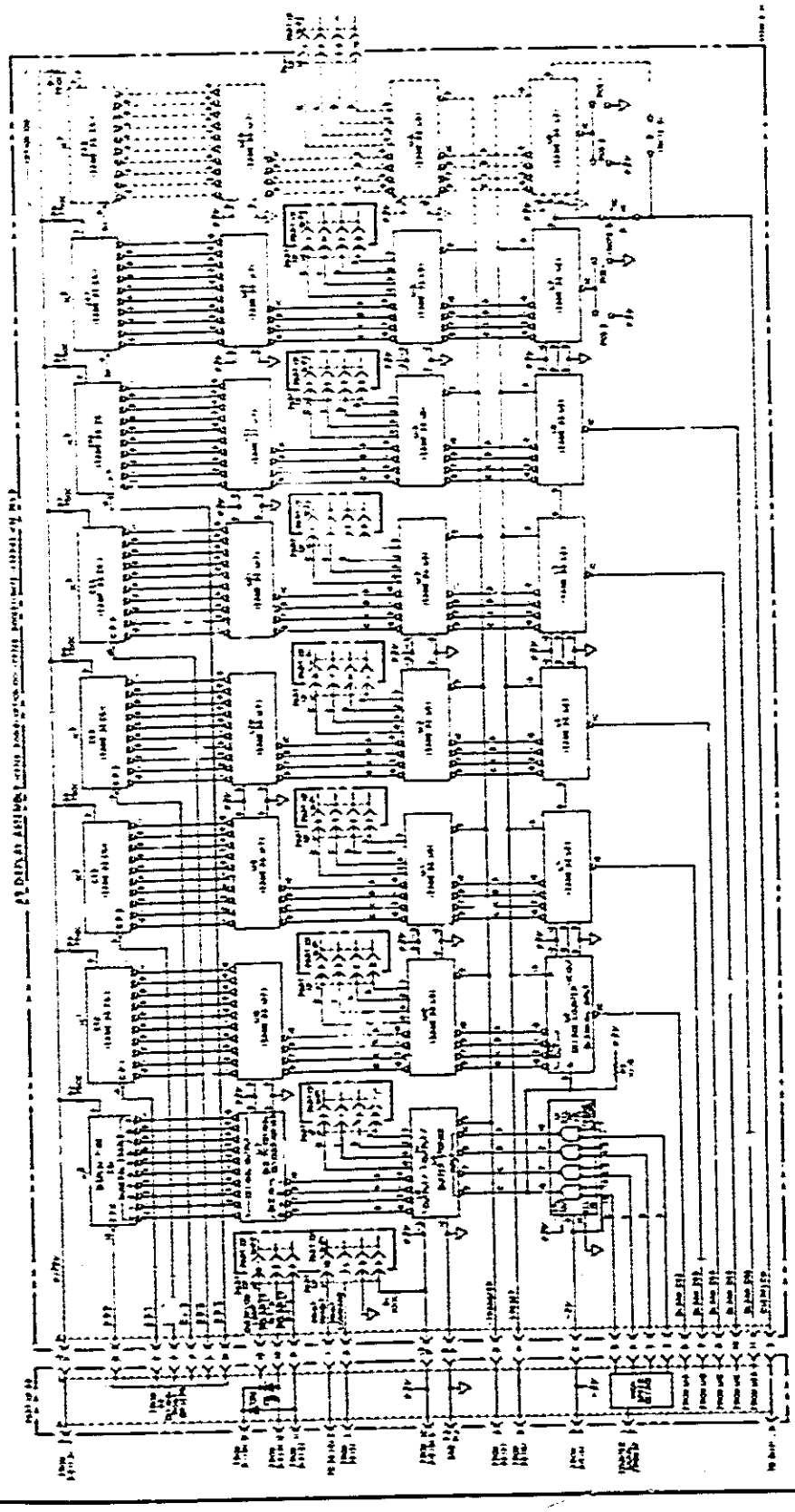


Figure 7-6. A9 Component Locator

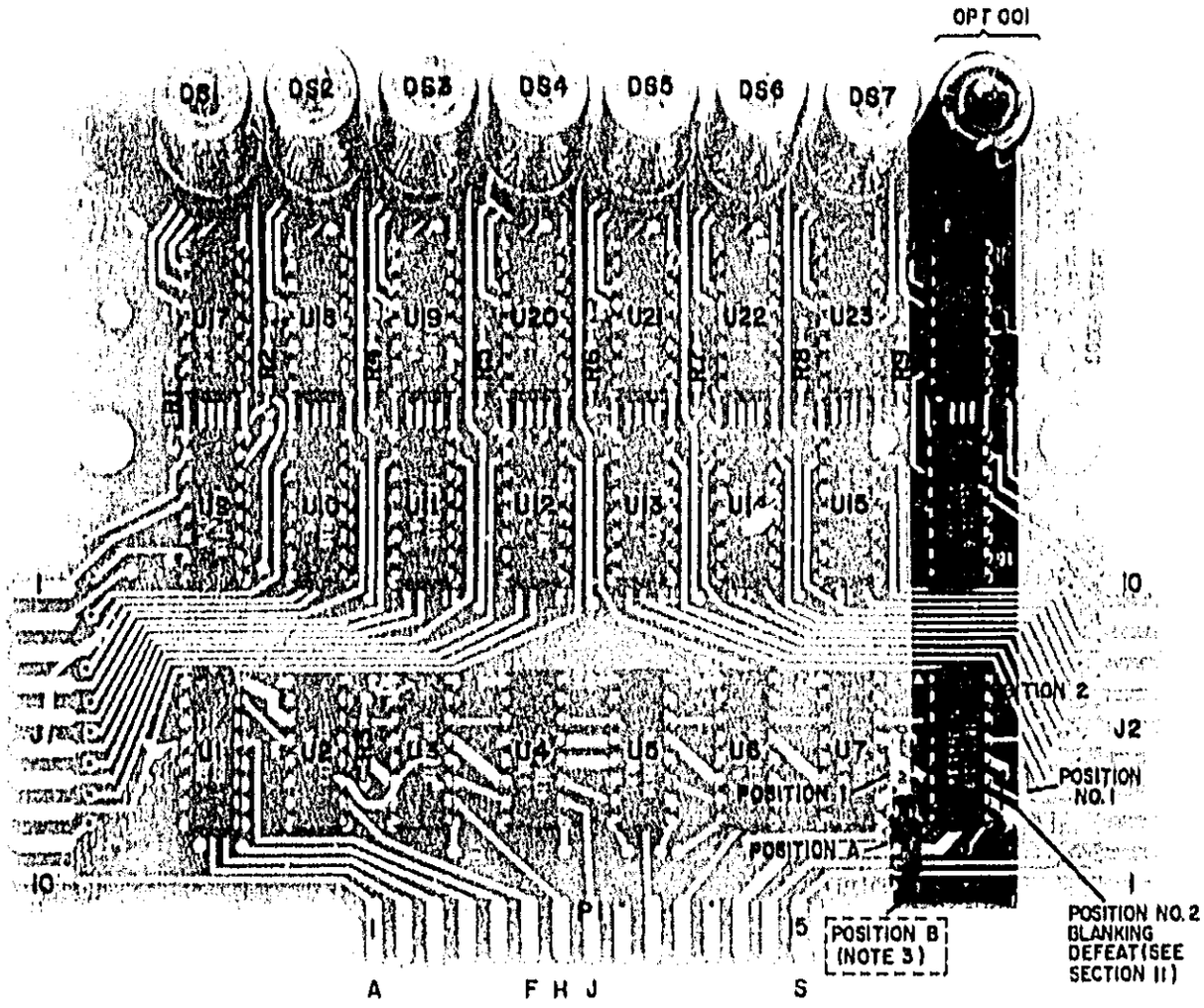


TABLE OF ACTIVE COMPONENTS

REFERENCE DESIGNATIONS	HP PART NUMBERS
A9	
CR1	1901-0040
CR2	1901-0016
A9	
U1	1820-0275
	MC1039P
U2-7	1820-0119
U9-15	1820-0116
U16-23	1820-0092
U17	1820-0729

Figure 7-7. A18 Schematic (05327-60009)

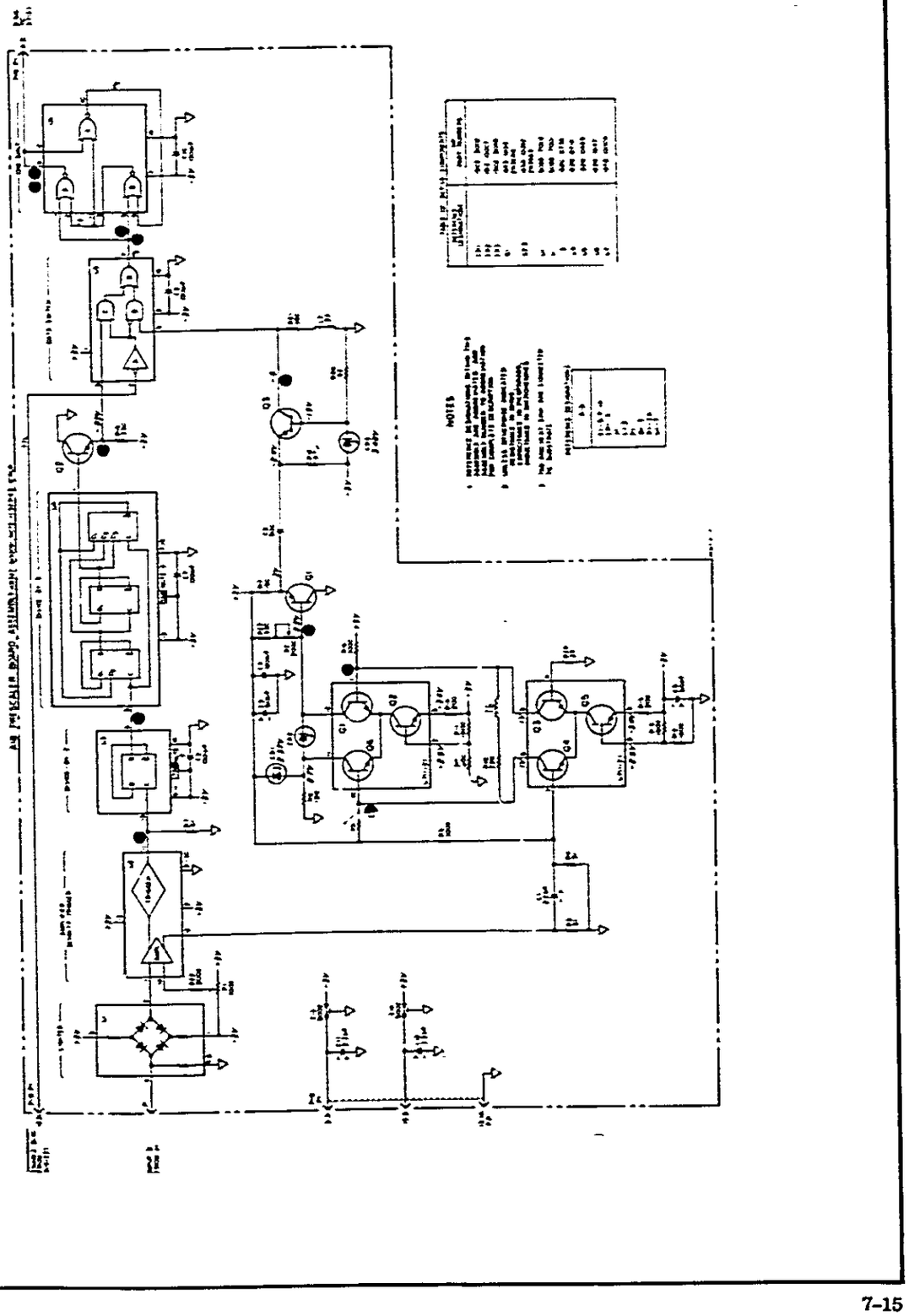
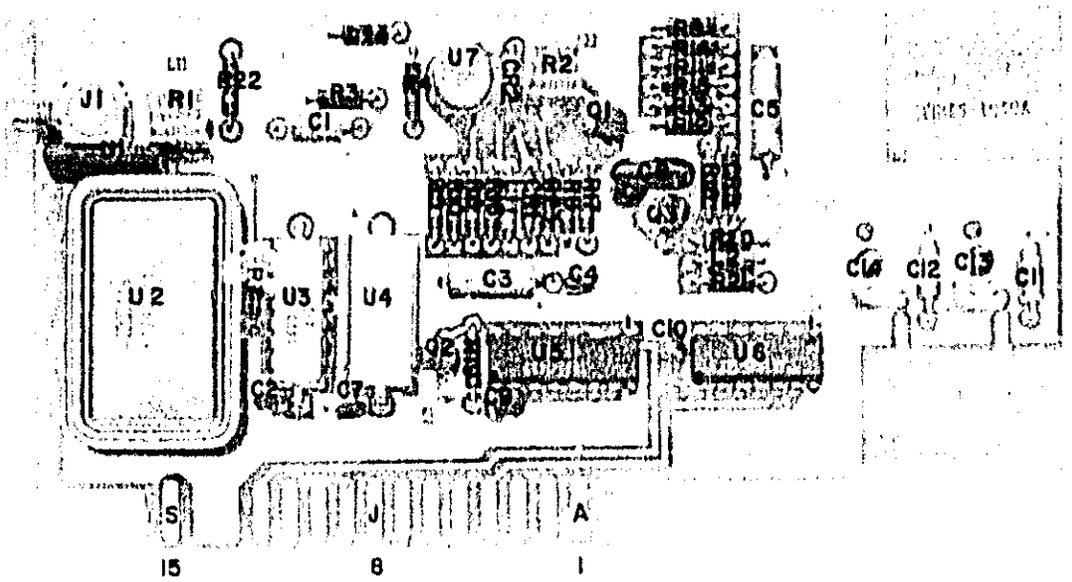


Figure 7-8. A18 Component Locator (05327-60009)



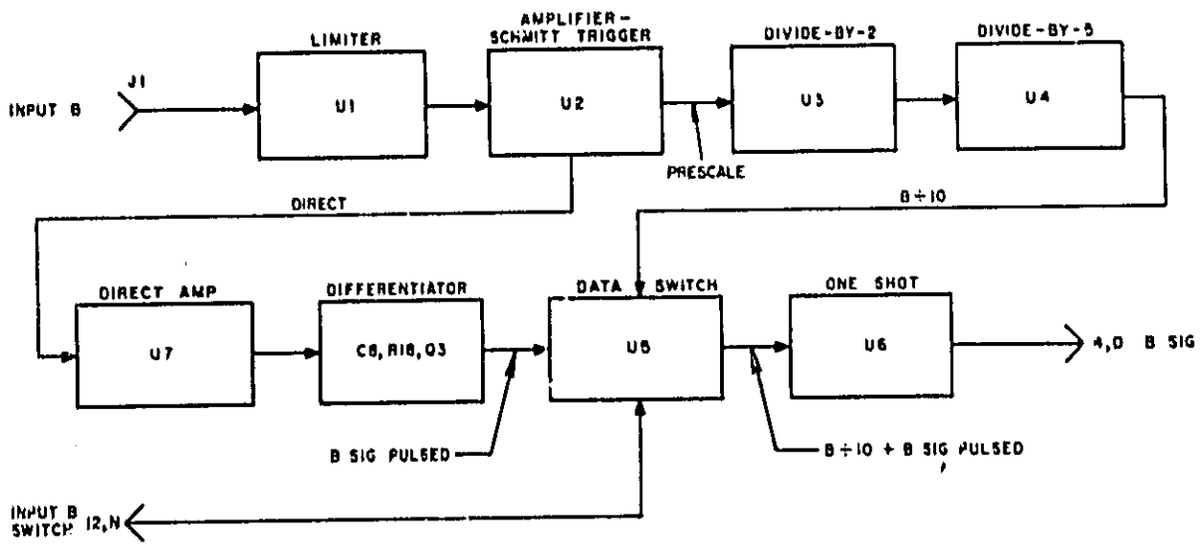


Figure 7-9. A18 Schematic (05327-60029)

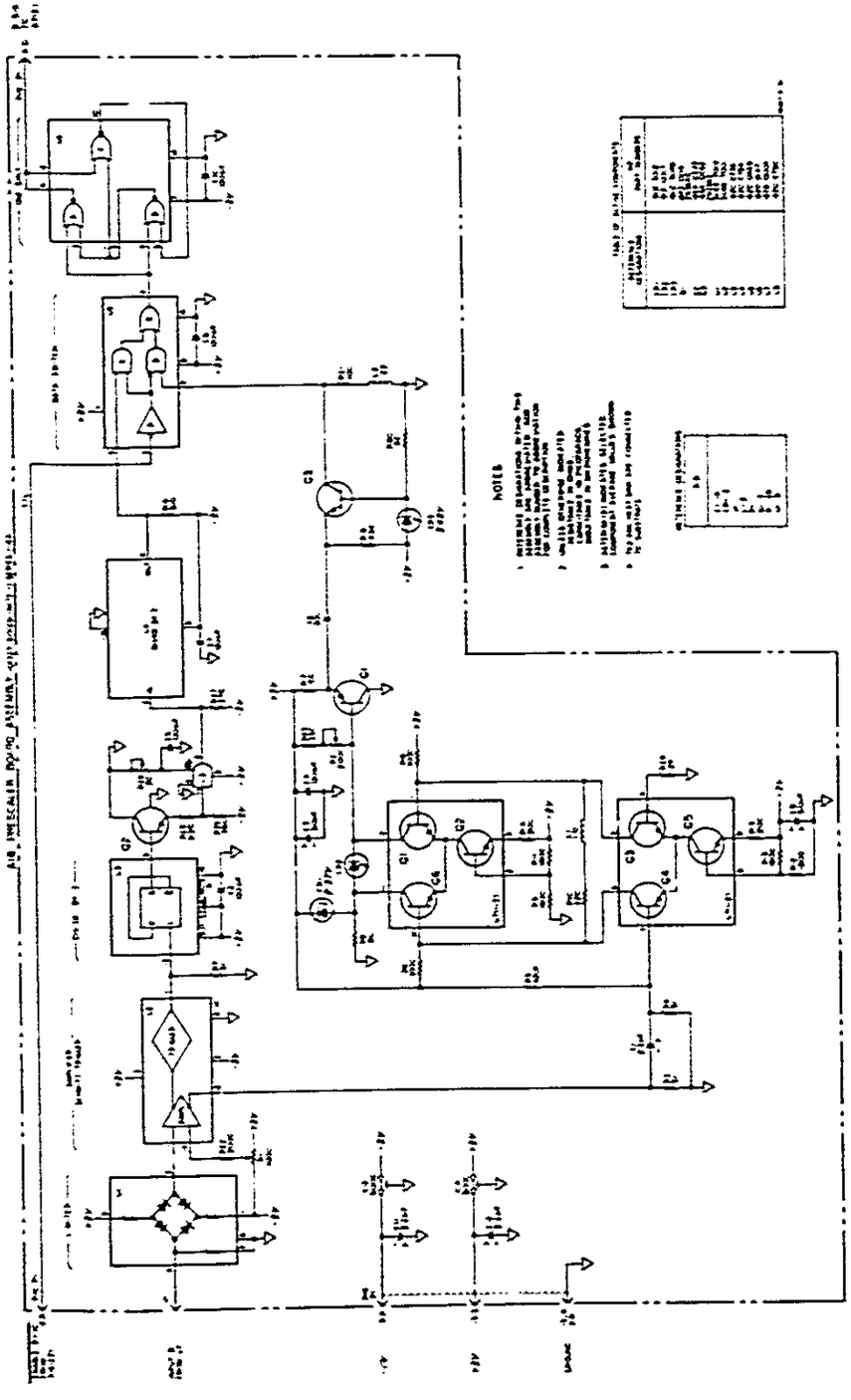
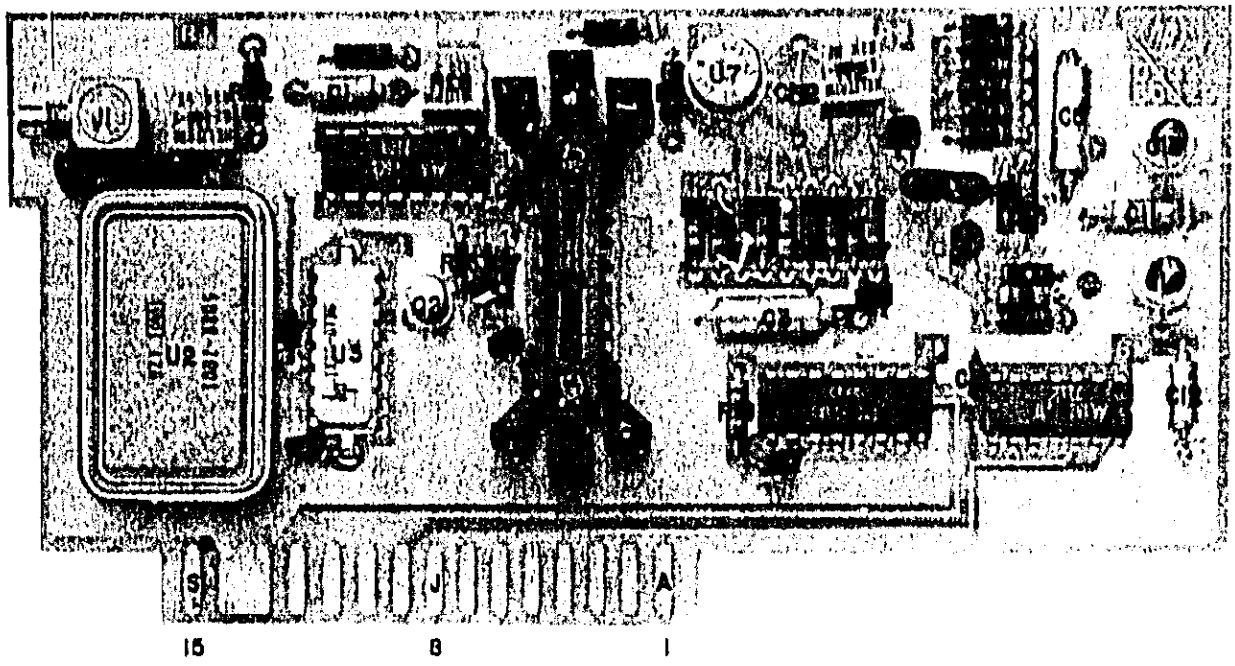
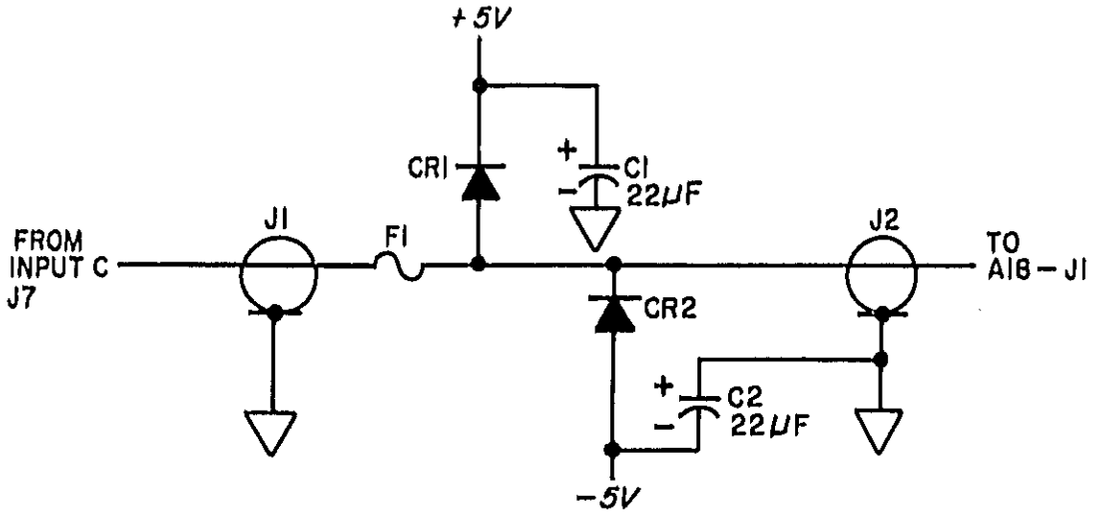


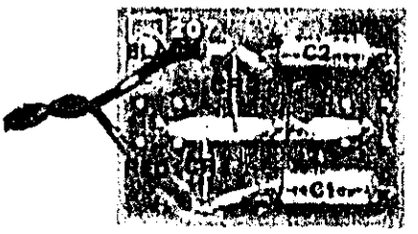
Figure 7-10. A18 Component Locator (05327-60029)

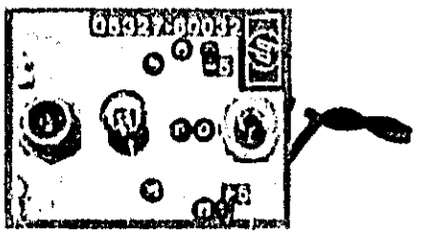


The 5327C model may be supplied with either A18 Prescaler Assembly. Both assemblies perform the same function. Note that separate schematics, component locators and parts lists are supplied for each assembly.

Figure 7-11. A19 Schematic, Component Locator, and Parts List

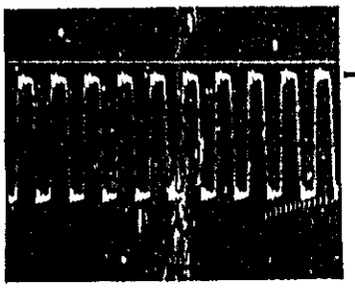




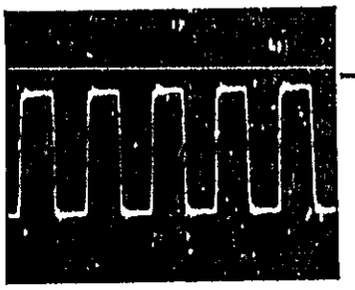


A19 05327-60032 Protection Board
A19 05327-20032 Blank Board
A19C1, 2 0160-0228 C:FXD TANT 22 UF 10% 15V
A19CR1, 2 1901-0050 DIODE:SILICON
A19F1 2110-0436 FUSE: 0.1 AMP
A19J1 1250-1408 CONNECTOR:RF SUBMINIATURE
A19J2 1250-0835 CONNECTOR:RF SUBMINIATURE
A19XF1A/B 1251-3205 SOCKET:MINIATURE (2)

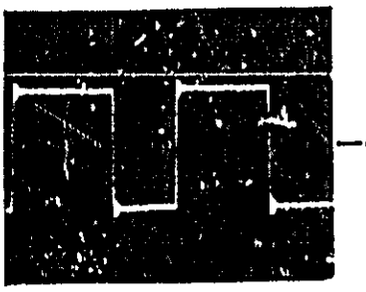
Figure 7-12. A18 Waveforms (05327-60009)



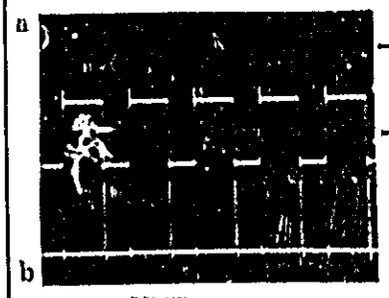
❶ .02 V/cm
.1 μs/cm



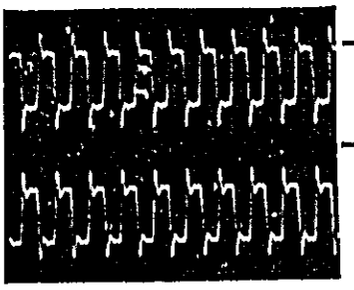
❷ .02 V/cm
.1 μs/cm



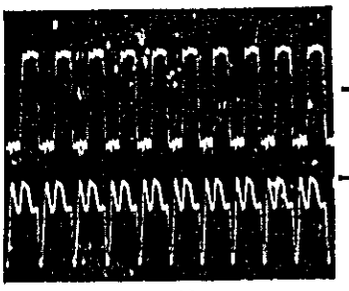
❸ .02 V/cm
.2 μs/cm



❹ a. U5(7)
b. U6(4)
.05 V/cm
.5 μs/cm

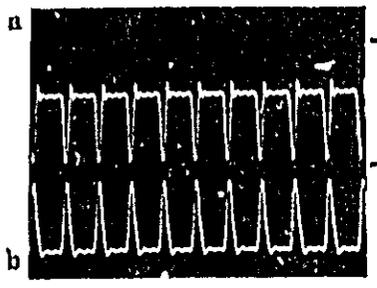


❺ a. U7(10)
b. U7(1)
.05 V/cm
.1 μs/cm



❻ a. Q1 - .02 V/cm
b. Q3 - .1 V/cm
.1 μs/cm

All waveforms taken with 10:1 divider probe; ground lead is connected to ground side of C5. A18 is mounted on extender board.



❼ a. U5(7)
b. U6(4)
.05 V/cm
.1 μs/cm
B position

COUNTER CONTROLS:
(except as noted)

INPUT B jack ..... connect 10 MHz sine wave at 1 V rms
INPUT SELECTOR ..... B
FUNCTION ..... FREQ
TIME BASE ..... 1 ms
CHK/NORM ..... NORM

OSCILLOSCOPE CONTROLS:

SWEEP MODE ..... AUTO
TRIGGER ..... INT
SLOPE ..... +
DISPLAY ..... for dual waveforms, use ALT B

DC VOLTAGES:

Set counter controls as stated. Disconnect input signal.

7-9. OPTIONS

7-10. Options 001 through 003 and Options 010 and 011 are available for the 5326C and 5327C and models. The following paragraphs describe each option's purpose and installation procedure.

7-11. Option 001, 8-Digit Display

7-12. Option 001 is the addition of an eighth digit to the display assembly. This addition becomes the most significant digit and extends the counter's display at higher frequencies. The digit is always blanked if the reading is "0".

7-13. Option 002, Remote Programming

7-14. Option 002 allows the counter to be computer controlled from a 36-pin connector on the counter's rear panel. Programming instructions are given in Section II. A schematic diagram is included in Section VIII, Interconnect Diagram.

7-15. Option 003, Digital Recorder Output

7-16. The data displayed on the counter's front panel can be permanently recorded by connecting a printer to the counter via Option 003. The necessary signals are coupled to an HP 5055A or 5050B Digital Recorder through J9 on the counter's rear panel (also, see Table 1-3 for specifications and interconnect diagram for pin references).

7-17. Option 010, Oscillator Assembly A4 (05327-60036)

7-18. Option 010 is a temperature-controlled crystal oscillator. This option replaces the standard A4 Oscillator Assembly and provides increased measurement accuracy. Specifications are given in Table 1-1. Schematic diagram is included in Section VIII.

7-19 Option 011, Oscillator Assemby A4, (10544-60011)

7-20. Option 011 is an oven-controlled crystal oscillator. This option replaces the standard A4 Oscillator and provides the highest stability available in the 5326/5327 Counters. Specifications are included in Table 1-1.

7-21. FIELD INSTALLATION OF OPTIONS

7-22. Installation of Option 001, 8th Digit

7-23. Parts required to install this option are:

1820-0119 Decade Counter U8
1820-0116 Buffer Storage U16
1820-0092 Decoder Driver U24
1970-0042 Display Tube DS8

a. Remove right and left readout boards, A10 and A11.

b. Remove two screws holding display tube shield and remove shield.

c. Remove display board A9 and display support board A8 from the counter by pulling up on the display support board A8. Separate A8 from A9.

d. Install parts on A9 as shown in the component location photo on Figure 8-12 of this manual.

e. Remove R10 to prevent overflow information from U7. R12 carries the overflow when Option 001 is installed. Replace boards in instrument.

f. Perform Self-Check in Figure 3-3. Especially note that the OF (overflow) lamp lights when the leftmost digit changes from 9 to 0.

7-24. Installation of Option 002, Remote Programming

7-25. To install remote programming capability in units not so equipped, order remote cable assembly HP Part No. 05327-60013, two 4-40 x ¼-inch machine screws, and one 6-32 x ⅝-inch machine screw with hex nut.

a. Remove the plate covering the lower opening in the rear panel for Option 002.

b. The rear-panel interconnect board containing the wiring for the rear-panel BNC's and switches must be removed. To accomplish this, remove the nuts holding the rear-panel BNC's.

c. Remove two screws holding P1A, the 1⅞-inch long, black, pressure connector to the motherboard A16.

d. Remove side covers and six screws holding rear panel. Loosen one side frame. Pull rear panel away from the instrument.

e. Remove the rear-panel interconnect board from the instrument and separate it from P1A by removing two screws.

f. Feed the pressure connector through hole in rear-panel and mount rear-panel connector J10, with screws removed earlier. Position J10 with pin 1 near the side frame.

g. Assemble the rear-panel interconnect board and the new 5-inch long pressure connector P1 with three 6-32 x ⅜-inch screws and hex nuts. Be certain that proper contact is made between interconnect board and P1.

h. Attach P1 to the motherboard using four 4-40 x ¼-inch screws. Do not tighten screws. Route cable as shown in the top internal photo of instrument, Figure 8-3.

CAUTION

Screws longer than ¼-inch will damage P1.

i. Gently reinstall rear panel. Install BNC lock nuts so that the board is still moveable.

j. Observe the alignment of the connector in the motherboard. Tighten the four screws holding P1 to the motherboard, making sure to maintain proper contact.

k. Check contact alignment of P1 with motherboard and with the rear-panel interconnect board. If necessary, loosen the screws in P1 and shift slightly to obtain proper terminal contact.

l. Tighten BNC lock nuts and reassembly instrument.

m. Run a complete performance check on the unit to verify that remote programming is working properly.

7-26. Installation of Option 003, Digital Recorder Output

7-27. Order digital recorder cable assembly HP Part No. 05326-60012.

a. Remove the plate covering the upper opening in the rear panel.

b. Remove right and left readout boards A10 and A11. Remove two screws holding the display tube shield and remove shield. Remove display support board A8 and the display board A9 by pulling up on A8.

c. Feed the two pressure connectors of the recorder cable through the rear panel and mount J9 on the rear panel, using the screws previously removed. Position J9 so pin 1 is near the side frame.

d. Slide the connectors on the A9 board, shown in the photo on Figure 8-3. The connector with the long wires attaches to J1 and is positioned so that pin 1 is toward the front of the instrument. The other connector attaches to J2, and pin 1 is toward the rear of the instrument.

e. Position the P1 cable so it passes between A8 and A11, completely clearing A8. Reinstall A8 and A9.

f. Route the cable around T1 as in the top internal photograph, Figure 8-3.

g. Reassembly unit and run a proof-of-performance check of the digital output to verify that the option is installed properly.

7-28. Installation of Option 010 and 011, Oscillator Assemblies.

7-29. Remove the standard A4 oscillator and insert the option into the XA4 connector. The Option 011 assembly must be mounted to the interconnect board with two 6 x 32, ⅜" screws. Place the fiber washers on the underside of the board.

SECTION VIII

CIRCUIT DIAGRAMS

This section contains the following:

a. Schematic diagram notes.

b. Component locators.

c. IC outline drawings.

d. Waveforms.

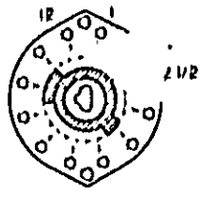
e. Simplified block diagrams.

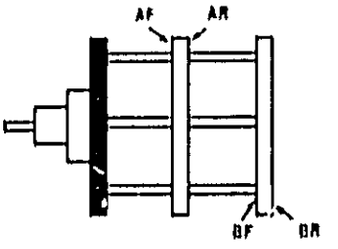
Figure 6-1. Schematic Diagram Notes

SYMBOLS

- FRONT PANEL
- REAR PANEL
- INTERIOR AND PC BOARDS
- WIPER MOVES TOWARD "CW" WHEN CONTROL IS ROTATED CLOCKWISE
- POWER LINE GROUND
- CIRCUIT COMMON GROUND
- FLOATING GROUND
- CHASSIS GROUND
- KNOB CONTROL
- SCREWDRIVER ADJUST
- MAIN SIGNAL PATH
- FEEDBACK PATH
- TEST POINT
- "AND" GATE
- "OR" GATE
- INVERTER
- NAND GATE
- NOR GATE
- EXCLUSIVE NOR

SWITCH DESIGNATIONS





A3S1		SWITCH S1 WITHIN ASSEMBLY A3
	B	2ND WAFER FROM FRONT (A=1ST, ETC)
	R	REAR OF WAFER (F=FRONT)
A3S1BR(2-1/2)	(2-1/2)	TERMINAL LOCATION (2-1/2) (VIEWED FROM FRONT)

REFERENCE DESIGNATIONS

REFERENCE DESIGNATIONS WITHIN ASSEMBLIES ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION. JACKS ARE THE STATIONARY CONNECTORS AND PLUGS ARE THE MORE MOVEABLE OF TWO CONNECTORS.

ASSEMBLY	ABBREVIATION	COMPLETE DESCRIPTION
A25	C1	A25C1
A25A1	CR1	A25A1CR1
NO PREFIX	J3	J3

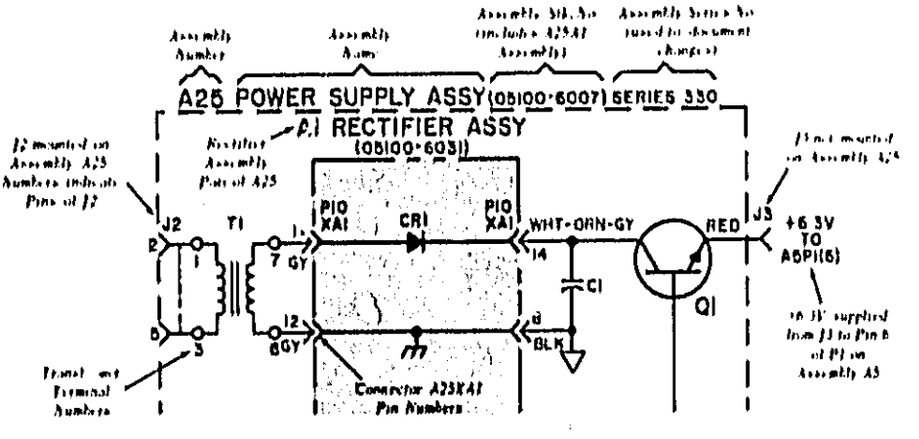


Figure 8-2. Front and Rear Panel Designations

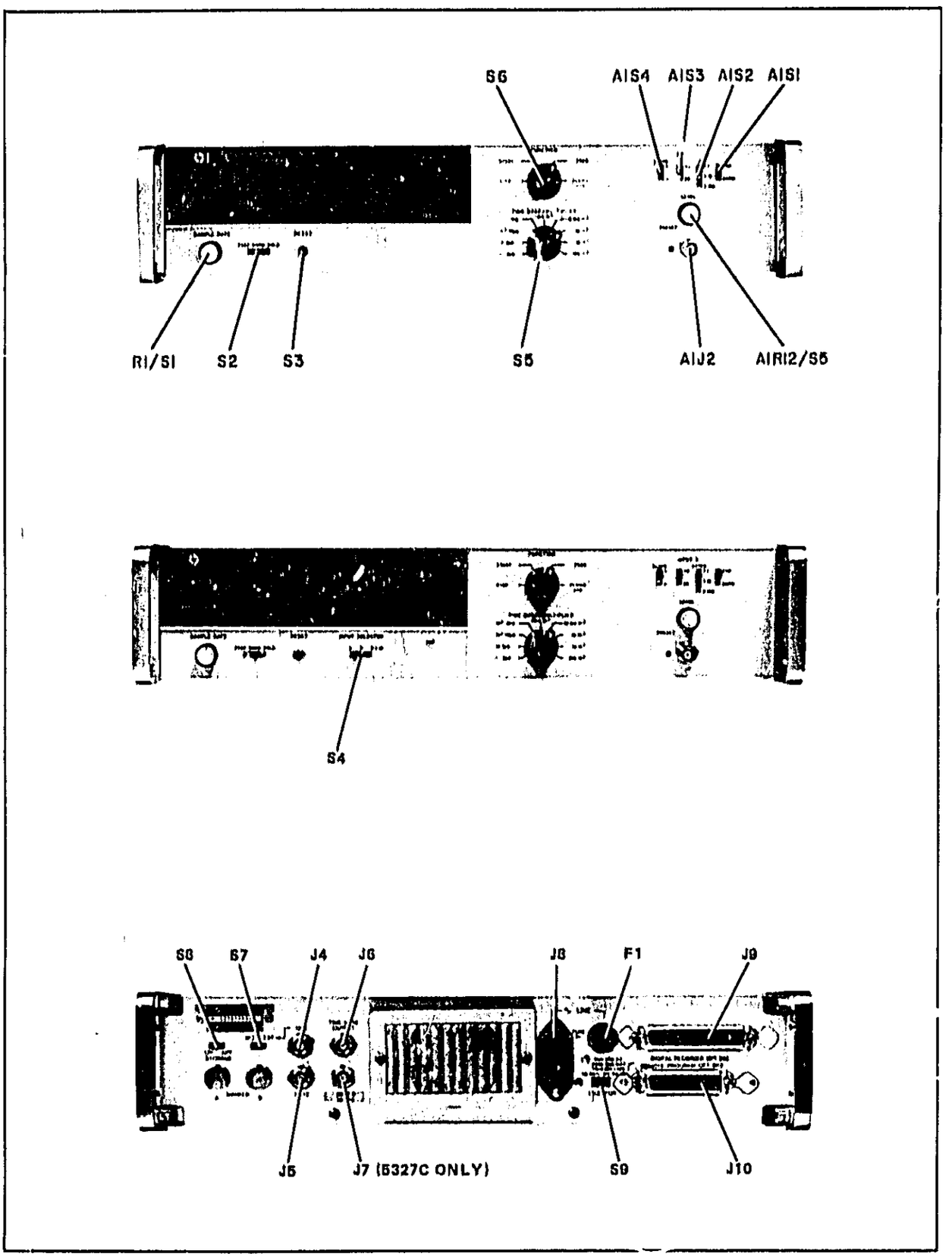


Figure 8-3. 5327C Top Internal (with Options)

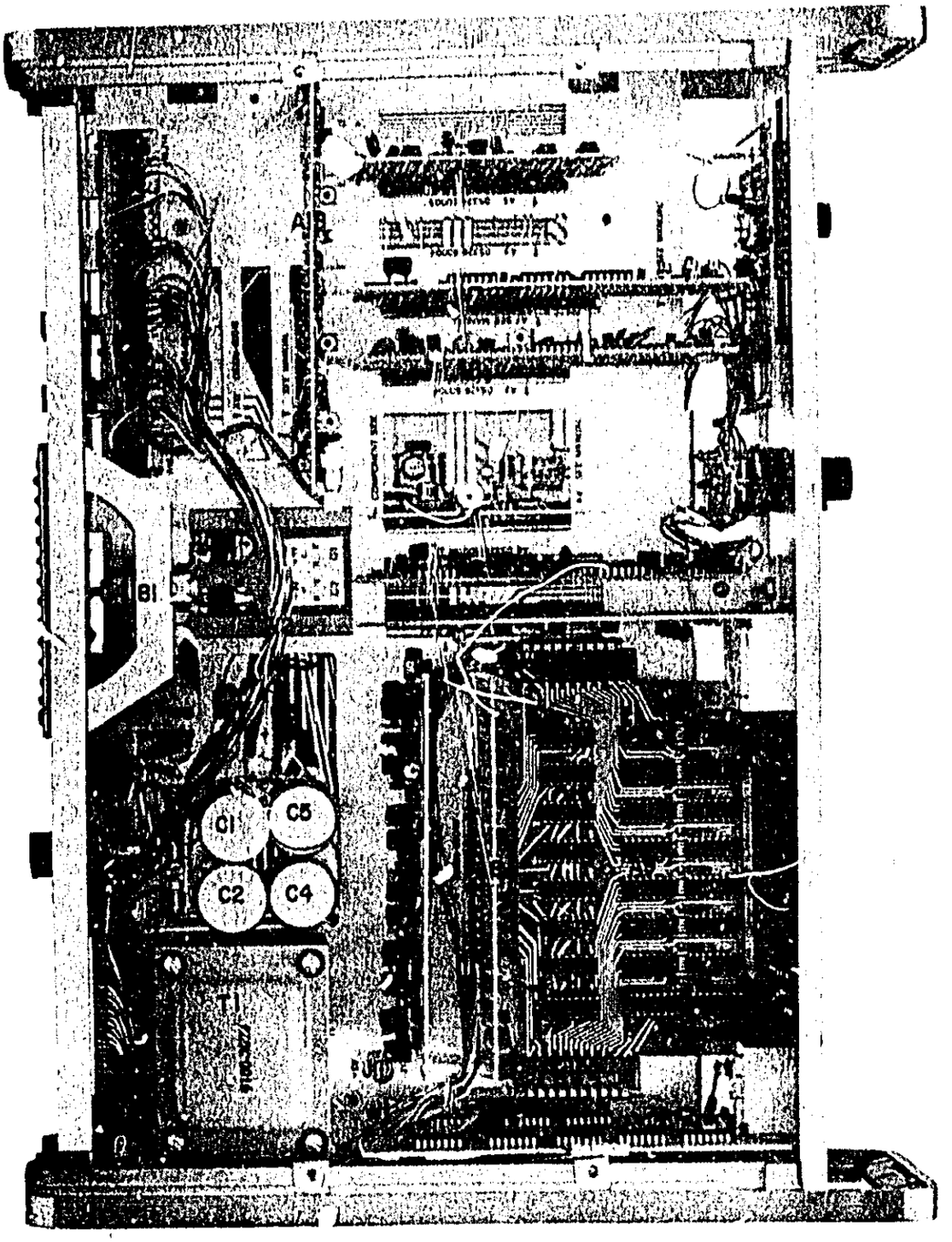
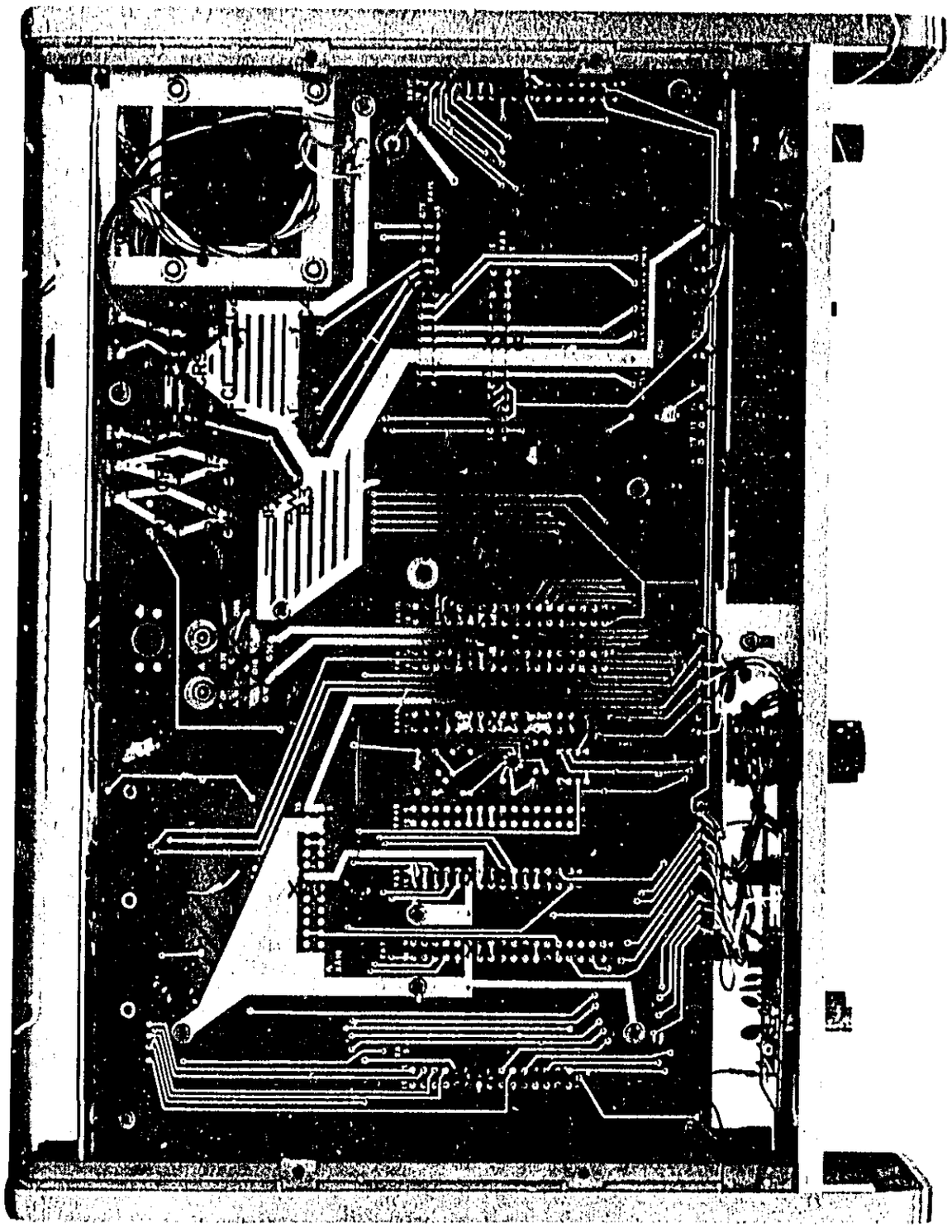
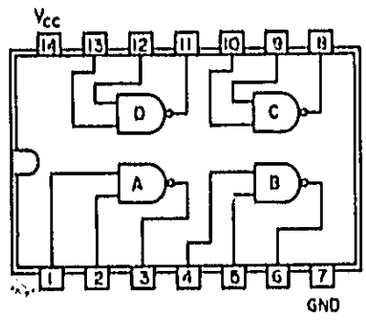


Figure 8-4. 5326C Bottom Internal

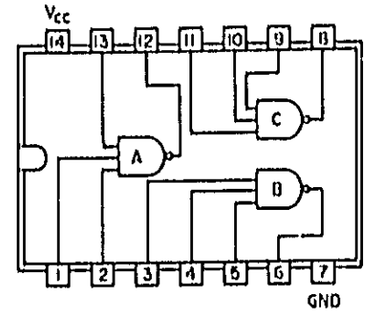


*Indicates A18 Prescaler connection for 5327C

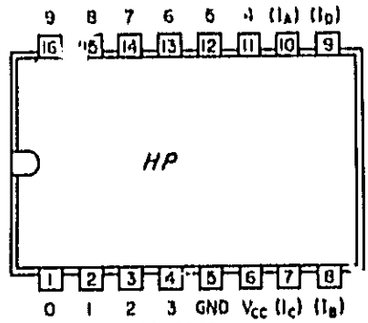
Figure 8-5. Integrated Circuit Diagrams



1820-0054(SN7400N)
QUADRUPLE 2-INPUT POSITIVE NAND GATE

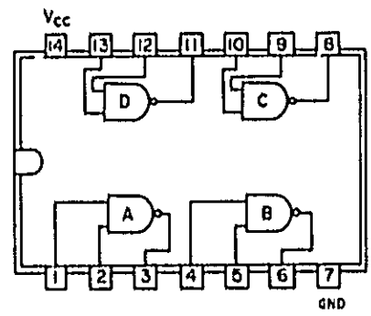


1820-0060(SN7410N)
TRIPLE 3-INPUT POSITIVE NAND GATE



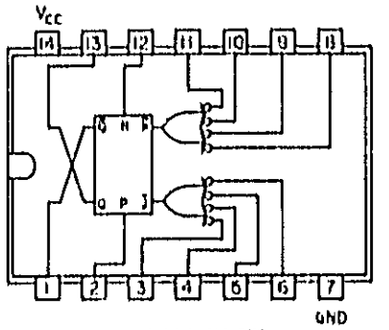
1820-0092
DRIVER
NEGATIVE LOGIC

$I_A(1)$	$I_B(2)$	$I_C(4)$	( )	"ON" OUTPUT
H	H	H	H	0
L	H	H	H	1
H	L	H	H	2
L	L	H	H	3
H	H	L	H	4
L	H	L	H	5
H	L	L	H	6
L	L	L	H	7
H	H	H	L	8
L	H	H	L	9
BCD 10-15				NONE



1820-0094(MC846P)
QUADRUPLE 2 INPUT POSITIVE NAND GATE

Figure 8-5. Integrated Circuit Diagrams (Continued)



(JC - 0102(MC1013P)
' 60MHz J-K FLIP-FLOP

R-S TRUTH TABLE

R	S	Q^{n+1}
12	2	13
0	0	Q^n
0	1	1
1	0	0
1	1	ND

ALL $\bar{J}\bar{K}$ INPUTS ARE STATIC

$\bar{J}_D \cdot \bar{K}_D$ TRUTH TABLE

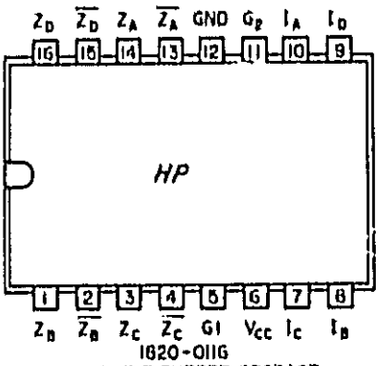
$\bar{J}_D$	$\bar{K}_D$	Q^{n+1}
↓	↓	13
0	0	Q^n
0	1	0
1	0	1
1	1	$\bar{Q}^n$

ALL OTHER $\bar{J}\bar{K}$ INPUTS AND THE R-S INPUTS ARE AT A "0" LEVEL

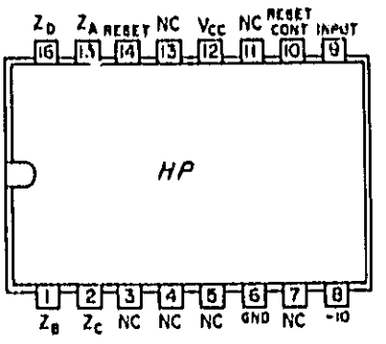
CLOCKED $\bar{J}\bar{K}$ TRUTH TABLE

$\bar{J}$	$\bar{K}$	C_D	Q^n
↓	↓	↓↓	13
ϕ	ϕ	0	Q^n
0	0	1	$\bar{Q}^n$
0	1	1	1
1	0	1	0
1	1	1	Q^n

ALL OTHER $\bar{J}\bar{K}$ INPUTS AND THE R-S INPUTS ARE AT A "0" LEVEL



1820-0116
4-BIT BUFFER STORAGE
(POSITIVE LOGIC)



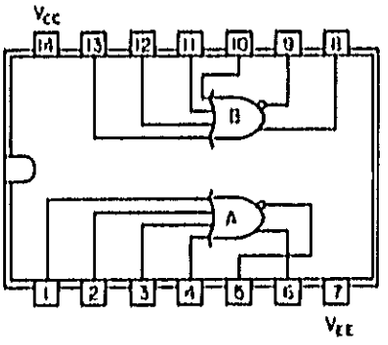
1820-0117,0119,0232
BLANKING DECADE COUNTER
NEGATIVE LOGIC 1= LOW
0= HIGH

TRUTH TABLE

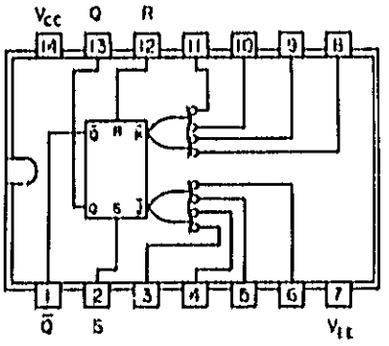
INPUT PULSE	OUTPUT A	B	C	D
0	H	H	H	H
1	L	H	H	H
2	H	L	H	H
3	L	L	H	H
4	H	H	L	H
5	L	H	L	H
6	H	L	L	H
7	L	L	L	H
8	H	H	H	L
9	L	H	H	L
RESET CONTROL HIGH & RESET PULSE	H	H	H	H
RESET CONTROL LOW & RESET PULSE	L	L	L	L

POSITIVE PULSE APPLIED TO RESET WILL:
A. RESET A,B,C & D TO LOW IF RESET CONTROL IS LOW.
B. RESET A,B,C & D TO HIGH IF RESET CONTROL IS HIGH
C. THE ÷10 OUTPUT WILL ALWAYS BE RESET TO HIGH STATE

Figure 8-5. Integrated Circuit Diagrams (Continued)



1820-0142(MC1004P)
ECL DUAL 4-INPUT OR/NOR



1820-0143(MC1027P)
ECL 120MHz J-K FLIP-FLOP

CLOCKED $\bar{J}$ $\bar{K}$ TRUTH TABLE

$\bar{J}$	$\bar{K}$	$\bar{C}_D$	Q^n
↓	↓	↓↓	13
ϕ	ϕ	0	Q^n
0	0	↑	$\bar{Q}^n$
0	1	↑	1
1	0	↑	0
1	1	↑	Q^n

ALL OTHER $\bar{J}$ $\bar{K}$ INPUTS AND THE R-S INPUTS ARE AT A "0" LEVEL

R-S TRUTH TABLE

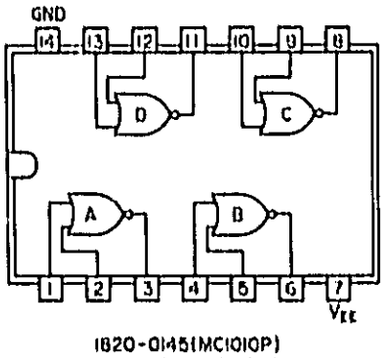
R	S	Q^{n+1}
12	2	13
0	0	Q^n
0	1	1
1	0	0
1	1	ND

ALL $\bar{J}$ $\bar{K}$ INPUTS ARE STATIC

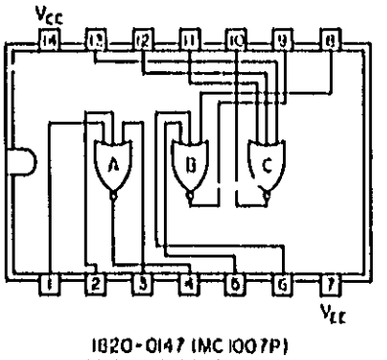
$\bar{J}_D$ $\bar{K}_D$ TRUTH TABLE

$\bar{J}_D$	$\bar{K}_D$	Q^{n+1}
↓	↓	13
0	0	Q^n
0	1	0
1	0	1
↓	↓	Q^n

ALL OTHER $\bar{J}$ $\bar{K}$ INPUTS AND THE R-S INPUTS ARE AT A "0" LEVEL

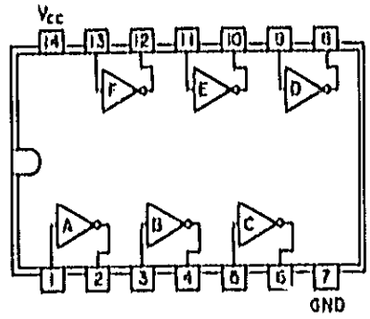


1820-0145(MC1010P)
ECL QUAD 2-INP NOR

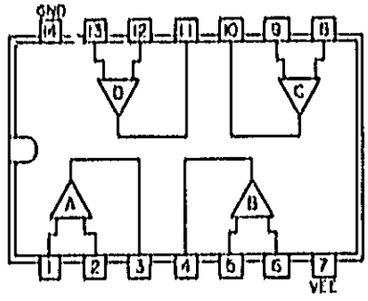


1820-0147 (MC1007P)
TRIPLE 3-INPUT GATES

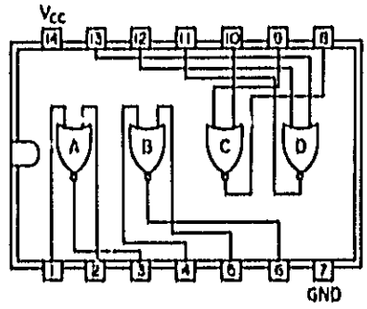
Figure 8-5. Integrated Circuit Diagrams (Continued)



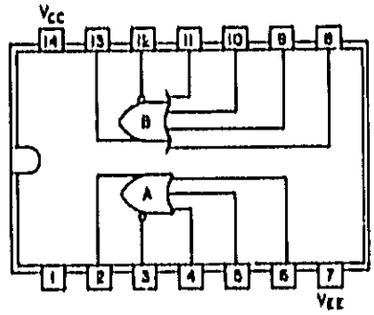
1820-0176, 0307
HEX INVERTER



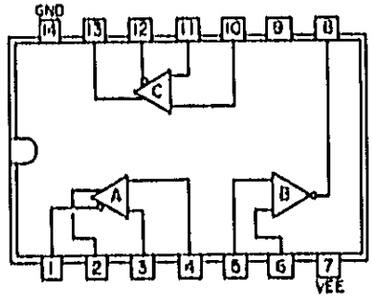
1820-0212
QUADRUPLE LINE RECEIVER



1820-0238 (MC1810P)
QUAD 2-INPUT NOR GATES

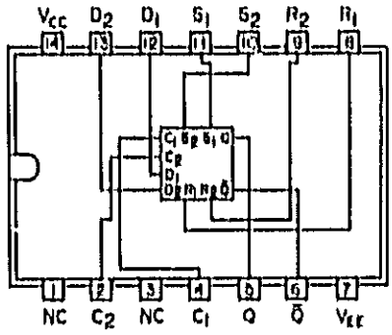


1820-0252 (MC1025, 1226)
OR/NOR



1820-0263
TRIPLE DIFFERENTIAL AMPLIFIER

Figure 8-5. Integrated Circuit Diagrams (Continued)



1820-0272 (MC1022P)
TYPE "D" FLIP-FLOP

CLOCKED TRUTH TABLE

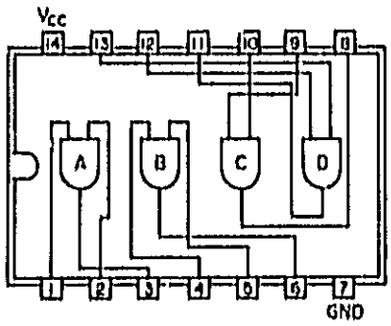
PIN No. D	PIN No. C	Q^{n+1}	$\bar{Q}^{n+1}$
12 or 13	2 or 4	S	S
0	0	Q^n	$\bar{Q}^n$
1	0	Q^n	$\bar{Q}^n$
0	1*	0	1
1	1*	1	0

*A "1" IN CLOCK INPUT IS DEFINED FOR THIS FLIP-FLOP AS A CHANGE IN LEVEL FROM A LOW INPUT TO A HIGH INPUT.

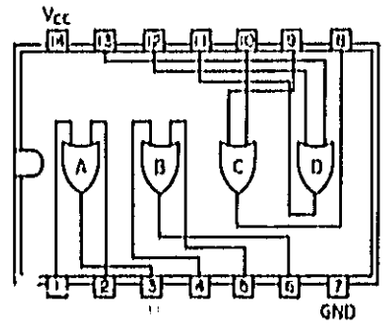
R-S TRUTH TABLE

PIN No R	PIN No S	Q^{n+1}	$\bar{Q}^{n+1}$
8 or 9	10 or 11	S	S
0	0	Q^n	$\bar{Q}^n$
0	1	1	0
1	0	0	1
1	1	N.D.	N.D.

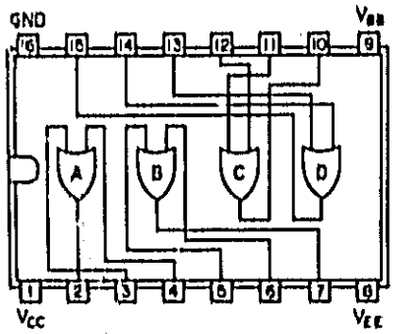
N.D. = NOT DEFINED



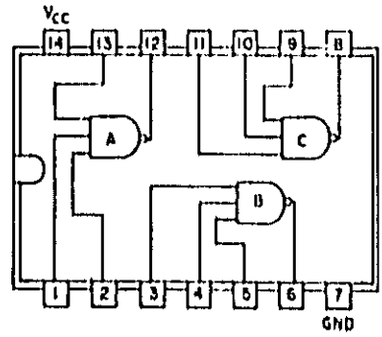
1820-0273 (MC1806P)
QUAD 2-INPUT AND GATES



1820-0274 (MC1808P)
QUAD 2-INPUT OR GATES

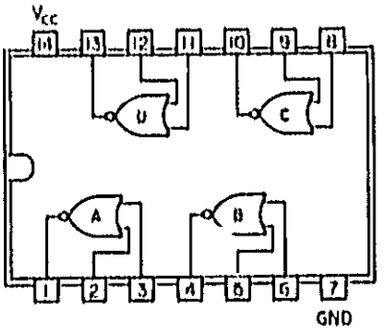


1820-0275 (MC1039P)
QUAD TRANSLATOR 2-INPUT OR GATES

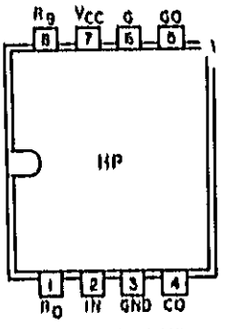


1820-0310 (MC862P)
3 INPUT NAND

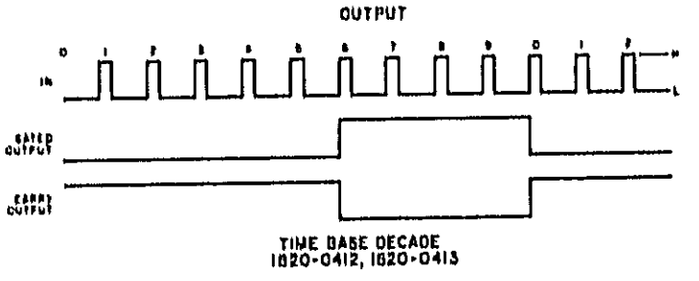
Figure 8-5. Integrated Circuit Diagrams (Continued)



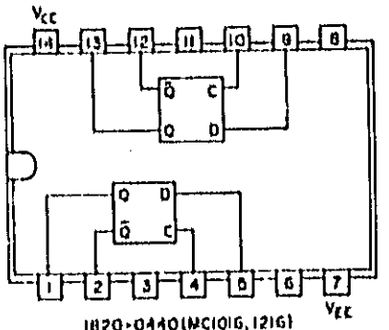
1820-0328(SN7402N)
QUAD 2-INPUT NOR GATE



1820-0412,0413
DECADE DIVIDER



TIME BASE DECADE
1820-0412, 1820-0413

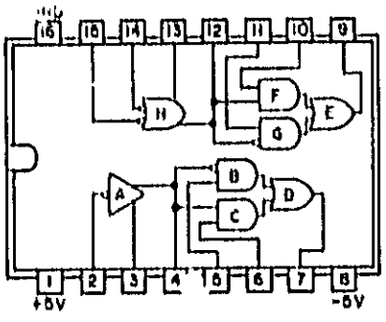


1820-0440(MC1016, 1216)
DUAL R-S FLIP-FLOPS

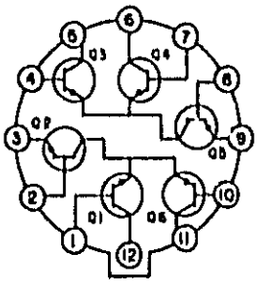
TRUTH TABLE

D	C	Q^{n+1}
0	0	Q^n
1	0	Q^n
0	1	0
1	1	1

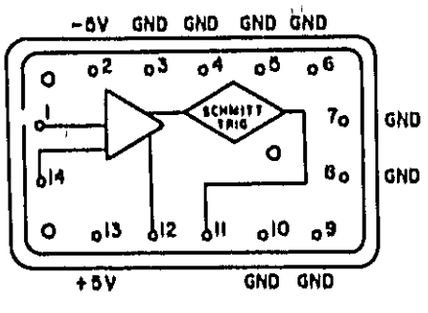
Figure 8-5. Integrated Circuit Diagrams (Continued)



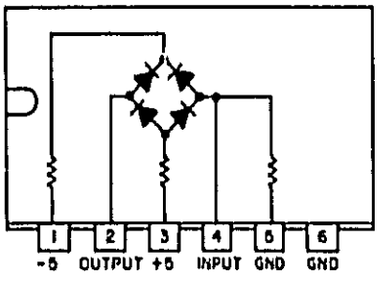
1820-0489
TRANSLATOR AND DATA
SWITCH



1858-0004
TRANSISTOR ARRAY
(BOTTOM VIEW)



5088-7001
SCHMITT B AMP



5088-7002
LIMITER

A1 ATTENUATOR OPERATION

Channel A input signals are routed through the front-panel input jack to the attenuator network. With the ATTEN switch in X1, the full input signal is fed to the gate of Q1A. When the ATTEN switch is set to X10, R2, R5, C1, and C3 serve as a 10:1 voltage divider. In the X100 position, the 100:1 voltage divider consists of R2, R4, C1, and C2. R3 provides damping.

For the check mode, the NORM-CHK switch grounds P1 via CR1. This programs A2 and A7 to disconnect the input signal and connect the 10 MHz internal oscillator signal.

When the AC/DC switch S4 is set to AC, C4 is in series with the signal path. CR3 and CR4 limit the input amplitude to Q1A to approximately ±3.8 V. R7 and R8 provide current limiting. C5 compensates Q1A input capacitance.

Q1A and Q1B form a differential amplifier, connected as source followers. Outputs are fed to A2 via pins 5 and 6 of J1. LEVEL potentiometer R12 determines the trigger level on Q1B gate. The trigger level can be preset to zero volts or varied from -3 to +3 volts. In addition, an external trigger level can be applied at J10 to A1J1(D) for remote programming. Diodes CR5 and CR6 develop a stable 5-volt reference for the input protection circuits and for the trigger level control. R11 lowers the impedance of Q1B gate circuit to limit stray charges and false triggering. R10 and C8 form a filter to prevent noise from triggering the differential amplifier.

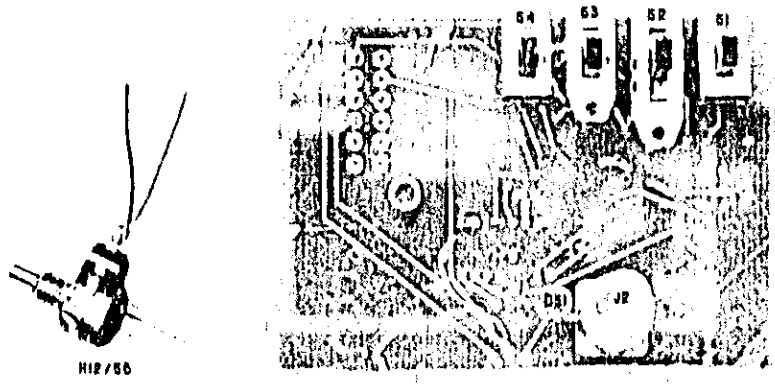
When the SLOPE switch is set to -, a Low is supplied to J1 pin A via CR2. This sets amplifier trigger A2 to trigger on the negative slope of the input signal. When remote programming is used, J1(C) is held High to disable the SLOPE switches.

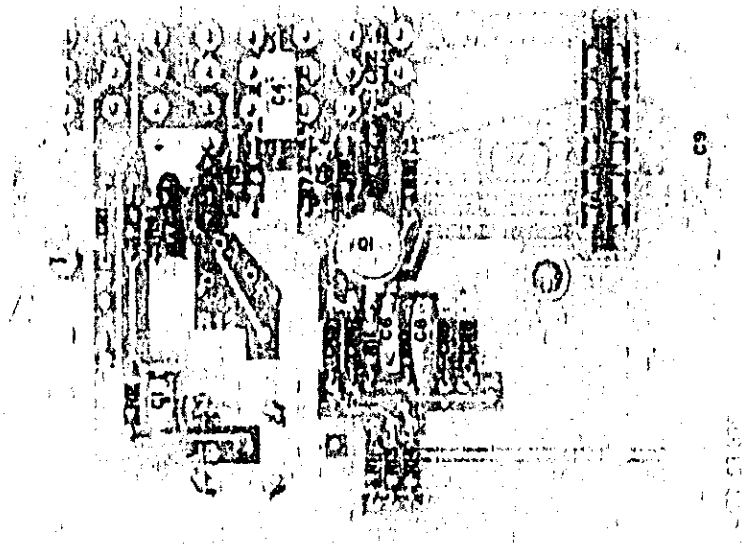
A4 OSCILLATOR OPERATION

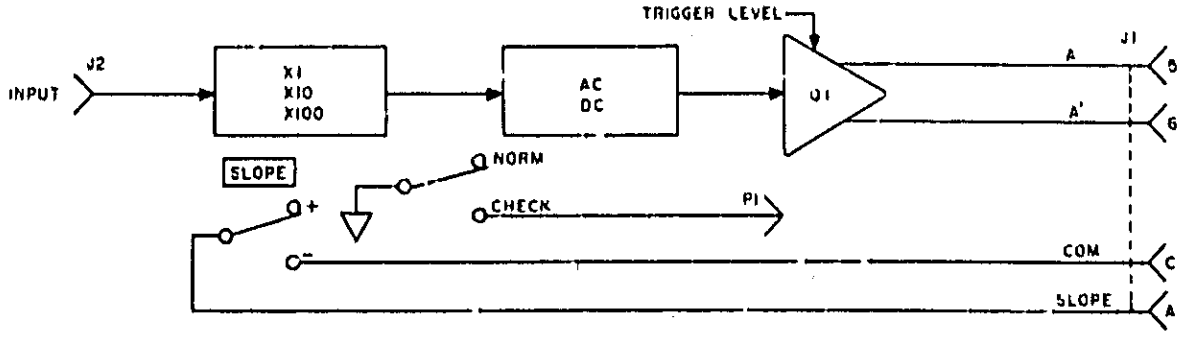
The 10 MHz oscillator assembly consists of oscillator U1A, buffer U1B, and level shifter Q1. U1A operates like an amplifier with positive feedback. The positive feedback path is from the noninverted output of U1A(6) through 10 MHz crystal Y1, trimmer capacitor C3, and C4 to U1A(4). Negative feedback is used to establish the input bias for U1A. The negative feedback path consists of R1 and R2. The inverted output of U1A(5) connects to buffer U1B(10). The buffer provides isolation between the oscillator and the output. The outputs of U1B(8) and (9) switch from approximately 3.5 to 4.25 volts. When one output is 3.5 volts, the other output is 4.25 volts. Level shifter Q1 converts the output of U1B to an approximate square wave of 0 to +4 volts.

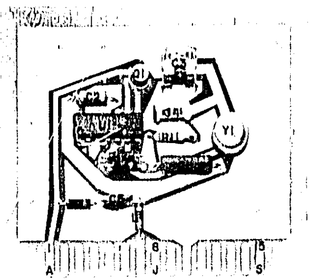
(see Figure 8-6)

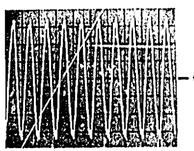
Part of Figure 8-6. A1/A4 Attenuator/Oscillator Board Assembly



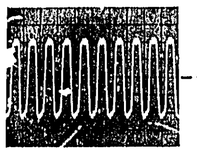




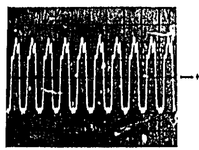




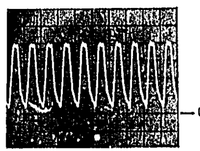
❶ .01 V/cm
.1 μs/cm
ac coupled



❷ .02 V/cm
.1 μs/cm
ac coupled



❸ .02 V/cm
.1 μs/cm
ac coupled

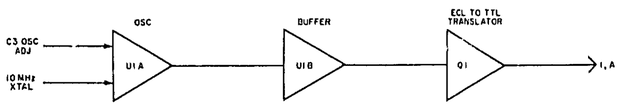


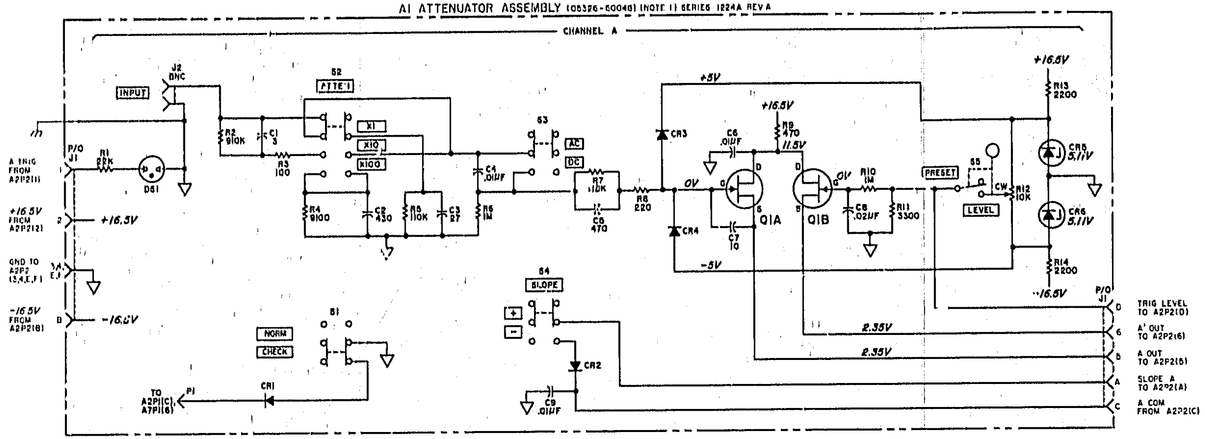
❹ .1 V/cm
.1 μs/cm

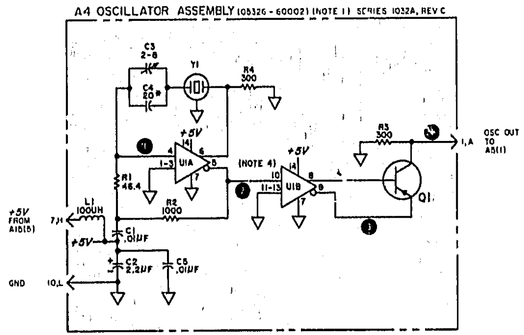
All waveforms taken through 10:1 divider probe. Divider probe's 8-½" ground lead is connected to ground side of C5.

COUNTER CONTROLS:

INT-EXT (rear panel) ..... INT







NOTES

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED: RESISTANCE IN OHMS, CAPACITANCE IN PICOFARADS; INDUCTANCE IN MICROHENRIES
3. ASTERISK(*) INDICATES SELECTED COMPONENT, AVERAGE VALUES SHOWN
4. U1 IS ECL LOGIC TYPE, HOWEVER:
   V_{CC} = +5VOLTS
   V_{EE} = GROUND
   H ≥ +4.18VOLTS
   L ≤ +3.80VOLTS

REFERENCE DESIGNATIONS

A1	A4
C1-9 CR1-6 DS1 J1,2 P1 Q1 R1-14 S1-5	C1-6 L1 Q1 R1-4 U1 Y1

TABLE OF ACTIVE COMPONENTS

REFERENCE DESIGNATIONS	HP PART NUMBERS
A1	
CR1	1901-0040
CR2	1910-0016
CR3,4	1901-0376
CR5,6	1902-0041
Q1	1855-0334
A4	
Q1	1850-0158
U1	1820-0142
Y1	0410-0405

05326-0-22

Figure 8-6. A1/A4 Attenuator/Oscillator Board Assembly

A2 AMPLIFIER/TRIGGER OPERATION

The input signal and the trigger level are received from A1 via P2(5) and P2(6), respectively. Potentiometer R2 is adjusted to cancel offset voltages that are due to imbalances in the circuit.

The differential amplifier (Q1 and Q8) serves to clip a small window out of the input signal waveform. The outputs of Q1 and Q8 drive another differential amplifier Q2 and Q6. Q2 and Q6 inject a current drive input to differential Schmitt trigger Q3, Q4, Q5, and Q7.

Q3 and Q7 are common base amplifiers, which present a low input impedance and high output impedance to Q4 and Q5. This arrangement allows for greater high-speed operation of Q4 and Q5. C2 and R15 reduce the hysteresis of the Schmitt trigger to give greater reliability at the high frequencies. Two out-of-phase signals from this circuit are routed to Q9 and Q10. The output levels shift from approximately +0.8 to +0.5 volts.

The SLOPE switch on A1 drives U1D(11) low for a +slope selection and U1A(3) low for a -slope selection. This allows either the in-phase signal or the out-of-phase signal to be switched to Q13 via Q10 and Q12 for +slope or via Q9 and Q11 for -slope.

The differentiator circuit consists of Q13 and feedback network L8 and R32. The circuit develops 10 ns pulses at the collector of Q13. CR3 and CR4 bias Q13 so that the collector circuit is compatible with ECL output driver U2B.

U2A(6) drives trigger-lamp driver Q16, Q17, Q18, Q19, and Q20. The circuit consists of RS FF Q16-Q17 and one-shot Q19-Q20. When U2A(6) is low, Q16 turns off and Q17 turns on. With Q17 on, Q18 cuts off to drive P1(1) high, which will light the trigger lamp DS1 on A1. As C8 charges, Q20 base goes positive. When Q20 base is approximately ground potential, the one-shot fires to turn off Q19 and Q17.

The marker circuit, Q15 and Q14, is a pulse stretcher that provides a low marker output at P1(12, N). When the input amplifier circuits trigger, U2B(8) provides a positive spike to Q14 base to drive Q14 collector below ground and allow CR5 to conduct. This makes the charge on C6 more positive. When U2B(8) returns to logical zero (approximately -1.6 V), Q14 is back biased and turns off, allowing Q15 to turn on to drive the marker output line low. After C6 has discharged through R36, Q14 turns on again, Q15 turns off, and the marker output line returns to the high state.

During the check mode, A1P1(C) is held high to disable U2B and enable U2A. With U2B disabled, the marker pulses are inhibited. With U2A enabled, the 10 MHz check signal at P1(4,D) connects to the amplifier output line P1(5,E).

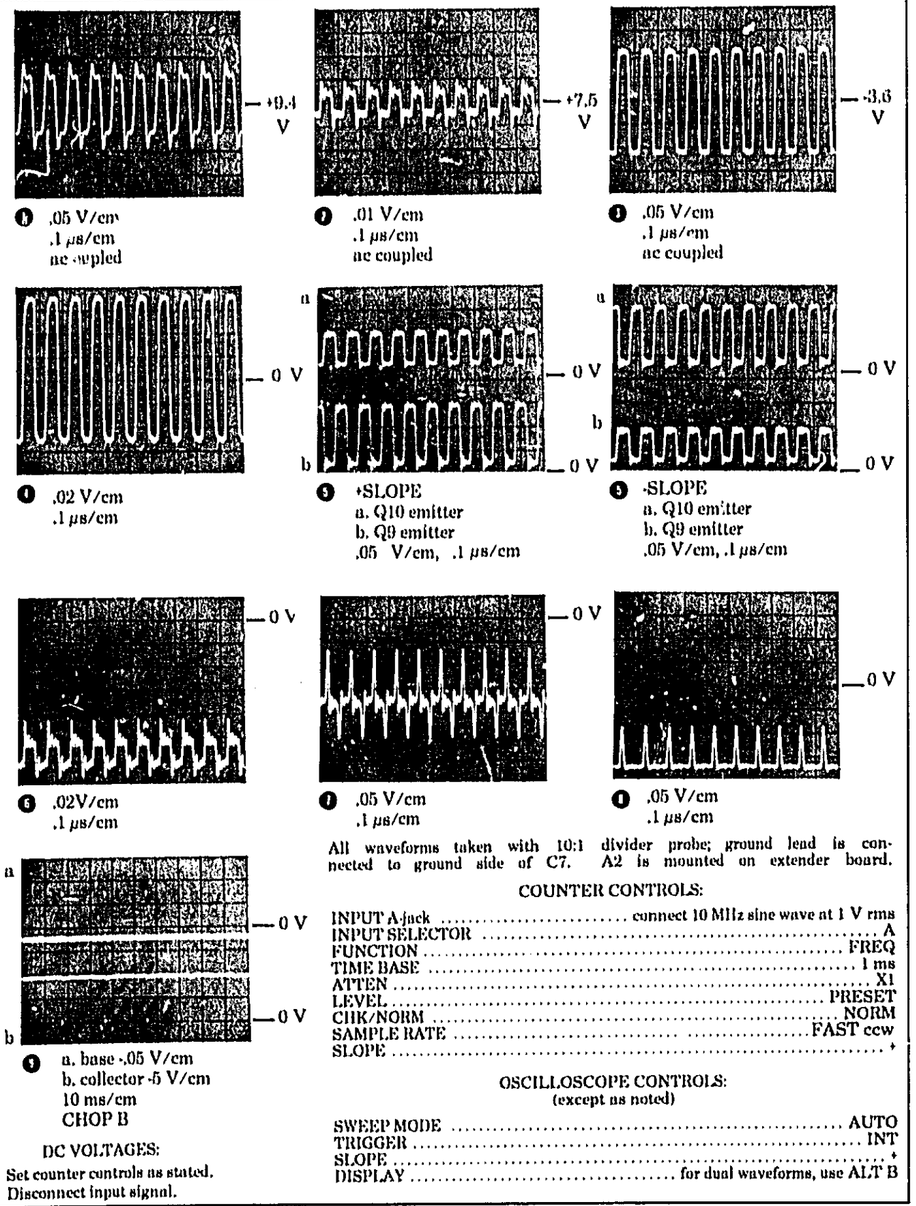
A2 TROUBLESHOOTING

When tracing the signal through the amplifier assembly, a good starting point is the collector of Q4, test point 4. With a sine wave input and the LEVEL control set to zero, this waveform should always resemble a square wave, due to the action of the Schmitt Trigger. A second check would be test point 6. If no signal is available there, check the slope gates of U1 and transistors Q9-Q12. Make use of the waveforms that are provided on this page. Once the problem is confined to a general area, use dc voltage checks to pinpoint the trouble.

Figure 8-6
A1/A4 ATTENUATOR/OSCILLATOR BOARD ASSEMBLY

(See Page 8-16)

Part of Figure 8-7. Input Amplifier Assembly



❶ .05 V/cm
.1 μs/cm
ac coupled

❷ .01 V/cm
.1 μs/cm
ac coupled

❸ .05 V/cm
.1 μs/cm
ac coupled

❹ .02 V/cm
.1 μs/cm

❺ +SLOPE
a. Q10 emitter
b. Q9 emitter
.05 V/cm, .1 μs/cm

❻ -SLOPE
a. Q10 emitter
b. Q9 emitter
.05 V/cm, .1 μs/cm

❼ .02V/cm
.1 μs/cm

❽ .05 V/cm
.1 μs/cm

❾ .05 V/cm
.1 μs/cm

❿ a. base -.05 V/cm
b. collector -5 V/cm
10 ms/cm
CHOP B

All waveforms taken with 10:1 divider probe; ground lead is connected to ground side of C7. A2 is mounted on extender board.

DC VOLTAGES:
Set counter controls as stated.
Disconnect input signal.

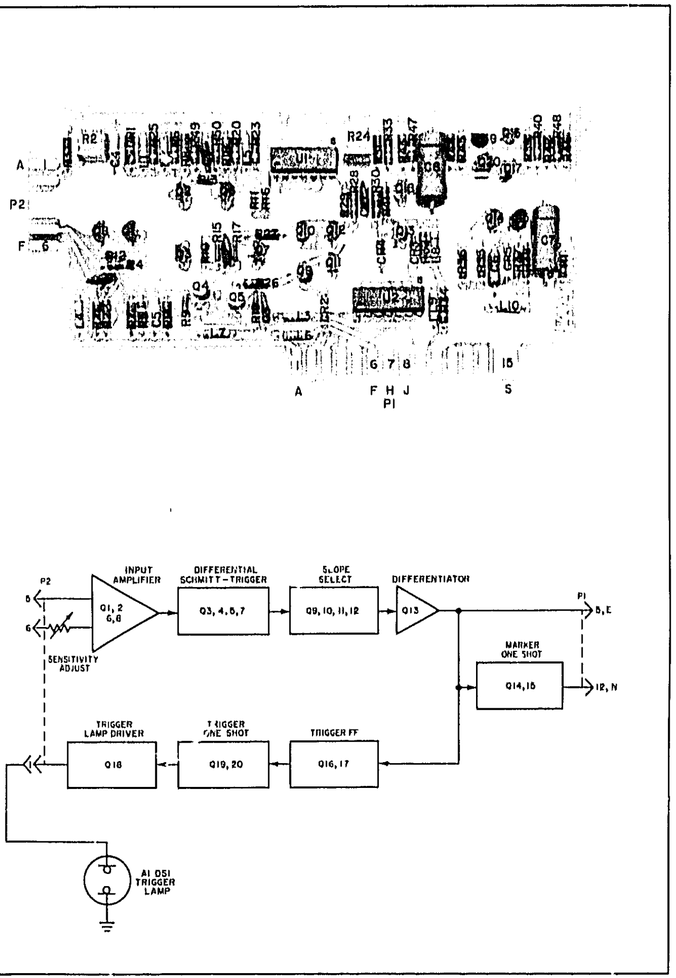
COUNTER CONTROLS:

INPUT A jack	connect 10 MHz sine wave at 1 V rms
INPUT SELECTOR	A
FUNCTION	FREQ
TIME BASE	1 ms
ATTEN	X1
LEVEL	PRESET
CHK/NORM	NORM
SAMPLE RATE	FAST ccw
SLOPE	+

OSCILLOSCOPE CONTROLS:
(except as noted)

SWEEP MODE	AUTO
TRIGGER	INT
SLOPE	+
DISPLAY	for dual waveforms, use ALT B

MORE DATA UNDER FOLD



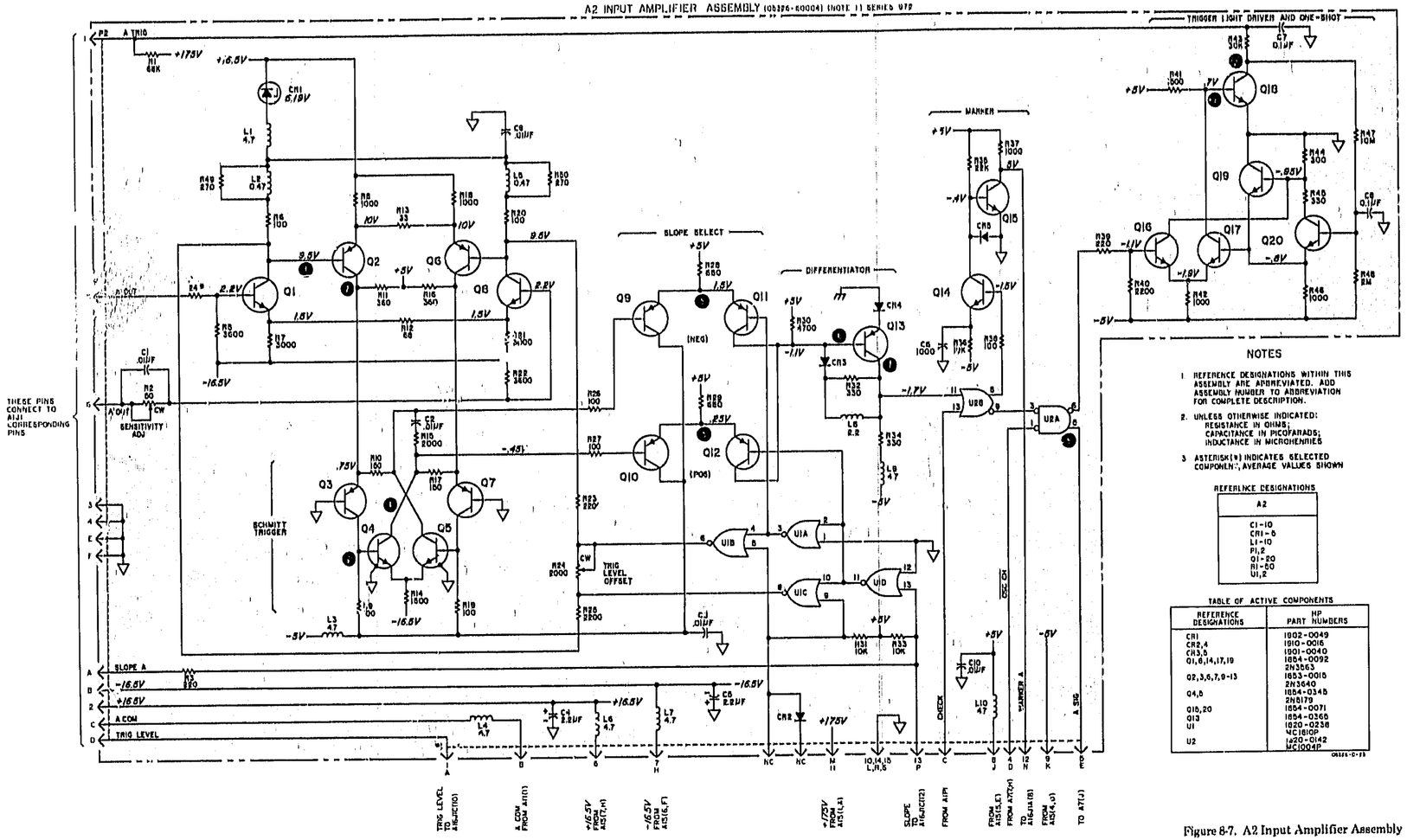


Figure 8-7. A2 Input Amplifier Assembly

Part of Figure 8-8, Time Base Control Assembly

A5 TIME BASE OPERATION

This assembly contains 8 decade dividers, which are controlled by TIME BASE switch S5. The input signal is 10 MHz for the frequency mode. For the totalize and period-average modes, the decade dividers receive INPUT A signals.

When a particular decade receives a gate-enable signal, the corresponding gated output line is enabled. For example, if S5 is set to .1 second U1(6) is grounded. This gates the divided signal out on U1(5). The gated outputs are connected together on a common line to C5. C5 differentiates the high to low transitions into approximately 100 ns pulses at U5C(8). When S5 is set to .1 µs, the input signal bypasses the decade dividers and passes through U10D and U5D. The output of U5C feeds through U10C to A7 and also through U10E to the rear-panel TIME BASE OUTPUT jack J6.

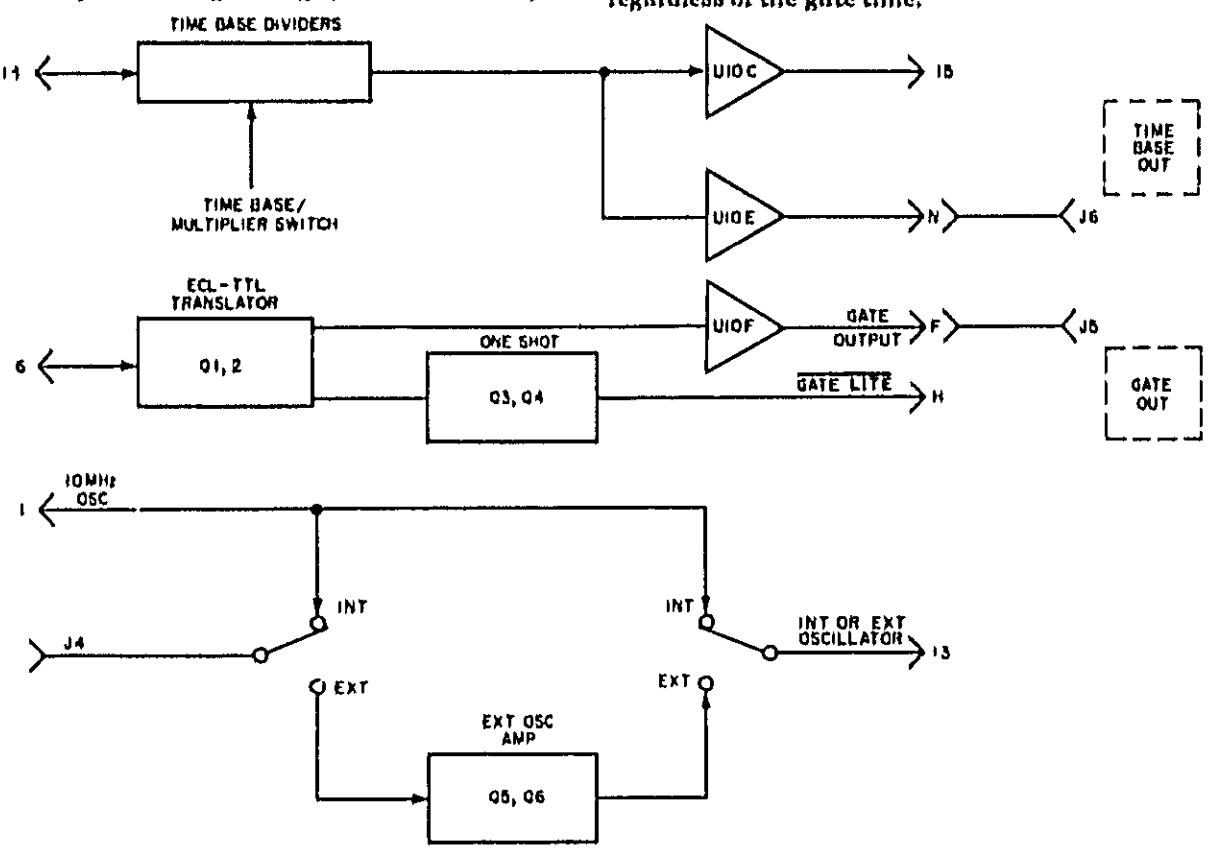
Q1 and Q2 form an ECL to TTL translator. When the main gate opens (low is main-gate enable), Q2 turns on the start one-shot Q3/Q4. During short gate-length times, this holds the gate lamp enable line low for approximately 50 ms to extend the time the gate lamp is on. When Q1 collector goes high, a low is developed at U10F(12) and routed to the GATE OUT jack J5.

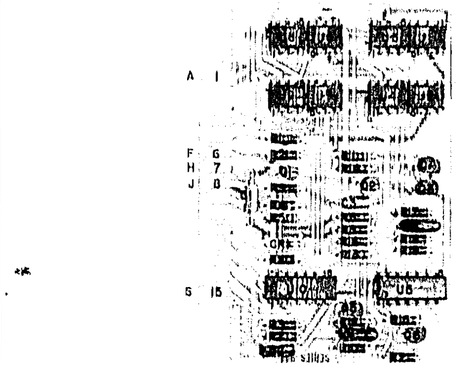
U5A and U5B select either the internal or external oscillator signal. When S7 is set to EXT, the internal oscillator signal is inhibited and the external oscillator signal passes through Schmitt trigger Q5 and Q6 to U5B and XA5(13).

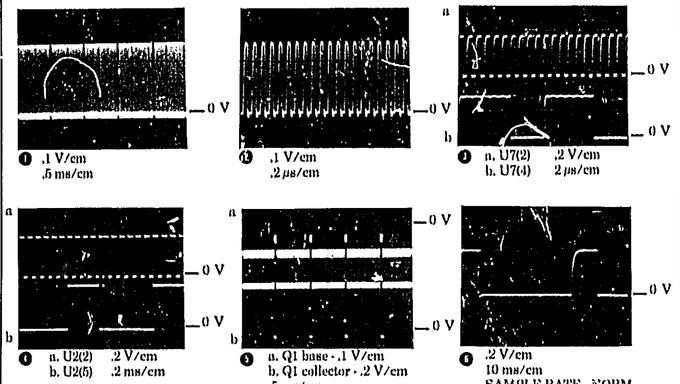
A5 TROUBLESHOOTING

When troubleshooting the Time Base Dividers, place the FUNCTION switch to START and CHK/NORM to CHK. Step the TIME BASE switch through each position and note the counter's display. When the counter stops totalizing, check for a low on pin 6 of the selected decade. If the counter does not totalize for any position of the TIME BASE switch, the problem is in the circuitry of U10B, U10C, or U5C. Before the gated output is sent to the A7 Function Control, it is differentiated by C5 and R15. This produces extremely sharp pulses, which are best observed when the gate time is 0.1 µs (TIME BASE switch).

To check the operation of the Gate Lamp one-shot, check for waveform 5 and 6 with SAMPLE RATE switch to NORM. The Collector of Q3 should be Low for about 50 ms, regardless of the gate time.







❶ .1 V/cm .5 ms/cm

❷ .1 V/cm .2 μs/cm

❸ a. U7(2) .2 V/cm
b. U7(4) 2 μs/cm

❹ a. U2(2) .2 V/cm
b. U2(5) .2 ms/cm

❺ a. Q1 base - .1 V/cm
b. Q1 collector - .2 V/cm
.5 ms/cm

❻ .2 V/cm
10 ms/cm
SAMPLE RATE NORM
SWEEP MODE - NORM

All waveforms taken with 10:1 divider probe; ground lead is connected to ground side of C1. A5 is mounted on extender board.

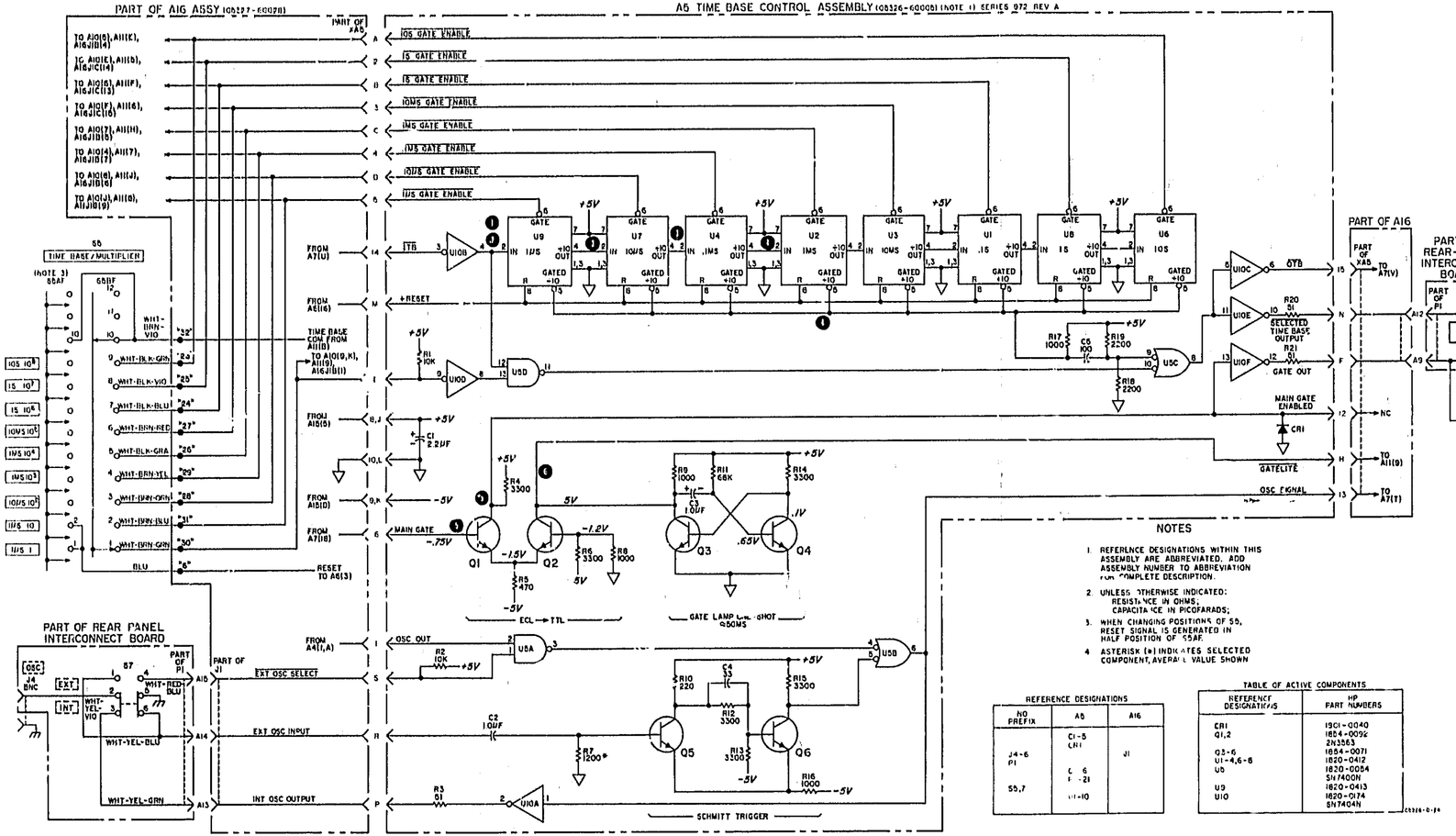
COUNTER CONTROLS:
(except as noted)

Use settings of A2 Assembly

DC VOLTAGES:
Set counter controls as stated.
Disconnect input signal. Push RESET.

OSCILLOSCOPE CONTROLS:
(except as noted)

Use settings of A2 Assembly



NOTES

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED: RESISTANCE IN OHMS; CAPACITANCE IN PICOFARADS;
3. WHEN CHANGING POSITIONS OF S5, RESET SIGNAL IS GENERATED IN HALF POSITION OF S5AF.
4. ASTERISK (*) INDICATES SELECTED COMPONENT, AVERAGE VALUE SHOWN

REFERENCE DESIGNATIONS

NO PREFIX	A5	A1G
J4-6 P1	C1-5 CR1	J1
S5,7	C 6 R -21 U1-10	

TABLE OF ACTIVE COMPONENTS

REFERENCE DESIGNATIONS	HP PART NUMBERS
CR1	1901-0040
Q1,2	1854-0092 2N3563
Q3-6	1854-0071
U1-4,6-8	1820-0412
U5	1820-0054 SN7400N
U9	1820-0413 SN7404N
U10	1820-0174 SN7404N

05326-0-24

Figure 8-8. A5 Time Base Control Assembly

A6 SAMPLE RATE OPERATION

The sample-rate circuits determine interrogation rates for the input signal and provide several functions for the various operating modes. These functions include generating reset, transfer, print command, and main-gate inhibit signals. In addition, the circuits receive computer inhibit, printer inhibit, and manual reset signals. The circuits also serve to control storage and display-hold functions.

As an example of operation, assume the following operating conditions: STORAGE to ON, SAMPLE RATE to FAST, no printer inhibit, no computer inhibit, no manual reset, and main gate open. At the end of the gate time, Pin 17 goes high, which sets inhibit flip-flop U2. This sends a signal to U6C to generate a high inhibit at U6B(9). In addition, a low is generated at Q4 collector to trigger the sample rate one-shot if no printer inhibit is present at U5B(6). The display time starts at this point, and the high at U5C(10) generates a low at U1D(11). The resulting high on U1C(8) turns on Q6, giving a low at the collector, which is the print command. Also at this time, the low on U1B(6) activates U4C through differentiator C5 to generate the positive and negative transfer signals at pins T and K, respectively.

When the sample rate one-shot is set, U1B(6) goes low to turn off Q7, allowing the +5 V supply and R41 - R1 to charge C4 for the display time. C3 is also connected for the NORM position. R1 varies the display time by varying the time required to bring Q8 base to a sufficient plus value to trigger Schmitt Trigger Q8 through Q10. This gives a high at U1A(1). The reset will be delayed until there is no print inhibit. U1A(3) will go low, generating a high at U3B(6), which is fed out at A6(16). The negative reset at U3C(8) is fed out at pin 9 in addition to being used to reset the sample rate one-shot.

The positive reset is used on A6 after passing through level shifter CR7 and CR8. The positive reset turns on Q1 and applies an ECL high to clear U2 and also turns on Q2, which maintains inhibit approximately 200 ns after the end of the reset pulse. At this time, the inhibit goes low and the main-gate circuits are free to function.

Q11 circuitry is a reset one-shot that ensures a sufficiently long reset pulse. The reset pulse width is approximately 40 µs or 400 µs, as determined by the FAST/NORM switch. For NORM sample rates. S2 switches C10 in parallel with C8. The sample rate disable line (pins 10, L) is low during START mode and maintains continuous transfer through CR3 and prohibits main-gate inhibit through U4D in addition to holding down Q8 base through CR2. This prevents the reset from being generated.

When STORAGE is OFF, U5A is activated to maintain transfer through CR4. The manual reset (pin 3) holds the reset one-shot in the ON state as long as the RESET button is depressed (reset low). It also maintains the transfer during the same time to clear the display. In addition, it turns on the main-gate inhibit, even if the main gate is open. The manual reset signal is low if the RESET button is depressed or if the TIME BASE or FUNCTION switch is between positions. (No reset is generated between start and stop positions.)

A6 TROUBLESHOOTING

Troubleshooting the Sample Rate board is best accomplished when the board is in a static state. The procedure given below examines each section separately when the circuit is in a working, but static, condition. Perform the tests in order listed. The schematic shows the circuit levels after RESET is pushed. These levels should be used as a reference.

NOTE

Do not use an input signal when performing the tests below.

MAIN GATE INHIBIT, PRINT COMMAND DRIVER, and SAMPLE RATE ONE-SHOT. Before troubleshooting, perform the procedure below.

FUNCTION switch ..... FREQ A
TIME BASE switch ..... 1 s
SAMPLE RATE switch ..... HOLD
SLOPE switch ..... +
CHK/NORM ..... NORM
STORAGE switch ..... ON
LEVEL control ..... full cw
Push RESET
LEVEL ..... full ccw
(Note that trigger lamp fires)

The purpose of this procedure is to set these circuits to the point immediately after the main gate closes. Varying the LEVEL control triggers a pulse to open the main gate for 1-second, and pin 17 goes Low during the gate time. U2 sets when the gate closes (positive transition) and remains set with the SAMPLE RATE switch set to HOLD. Once U2 sets, check for a Low on U5C(8). This generates a High on U1C(8) and a Low on U1D(6). Check that U4C(8) pulses High and Q6 collector sets Low. The main gate inhibit line at U6B(9) should now be High. The collector of Q7 is not now affected.

SAMPLE RATE INHIBIT. The sample rate inhibit gates are controlled by the FUNCTION and STORAGE switches and by a print inhibit signal. With the controls set as above, check for the levels shown on the schematic.

SCHMITT TRIGGER. The Schmitt Trigger and Q7 should be checked by using an input signal. Set the counter controls as listed under the waveforms. In waveform five, the repetition rate of the pulses changes with gate time, but pulse width remains the same. Pulse width changes with the SAMPLE RATE controls, but not spacing.

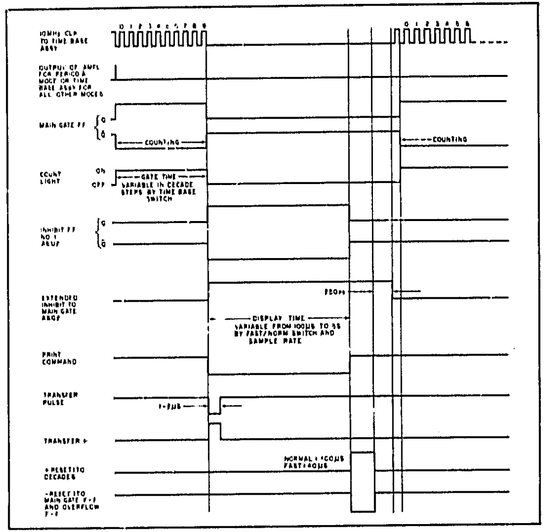


Figure 8-8
A5 TIME BASE CONTROL ASSEMBLY

(See Page 8-19)

Part of Figure 8-9. Sample Rate Board Assembly

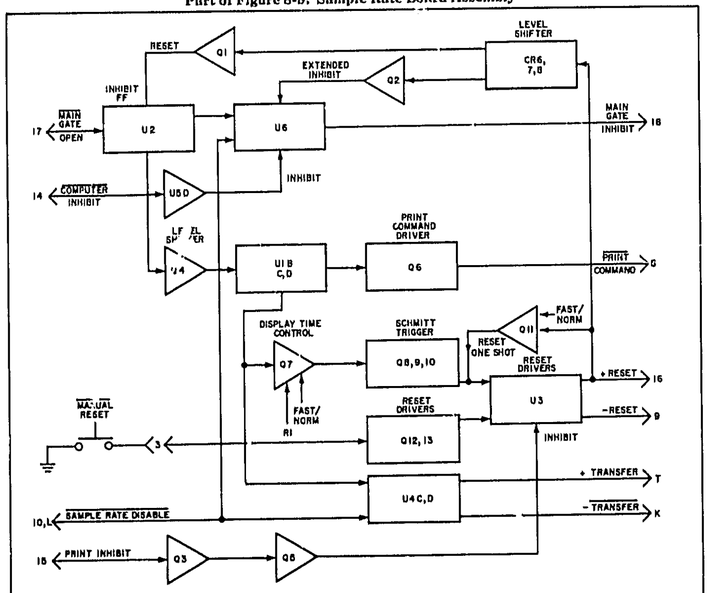


TABLE OF ACTIVE COMPONENTS

REFERENCE DESIGNATIONS	HP PART NUMBERS
CR1, 2, 5, 7, 8, 10, 11 Q1-3, 5, 6, 8-10, 12, 13 Q4, 11	1901-0040 1854-0071 1854-0009 2N709
Q7	1854-0215 2N3904
U1, 4	1820-0054 SN7400N
U2	1820-0272 MC1022P
U3	1820-0068 SN7410N
U5	1820-0328 SN7402N
U6	1820-0147

5326-8-5

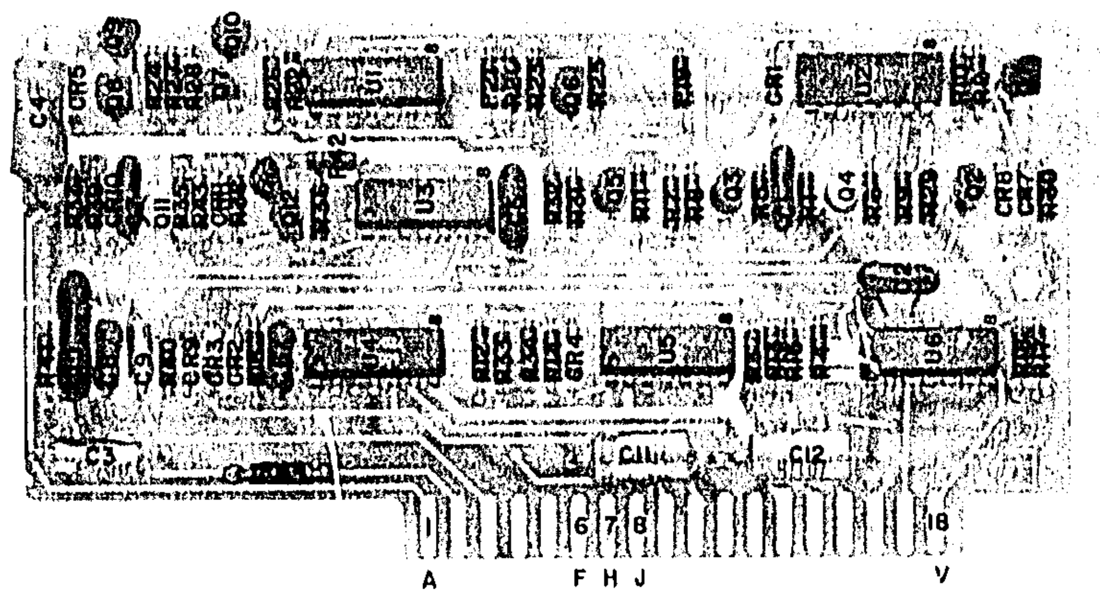
REFERENCE DESIGNATIONS

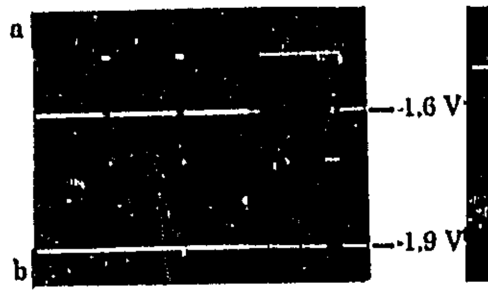
NO PREFIX	A6	A16
	C1-12 CR1, 5, 7-11	
	Q1-13 R1-44	J1
R1 S2, 3, 5, 6, 8		
	U1-6	

NOTES

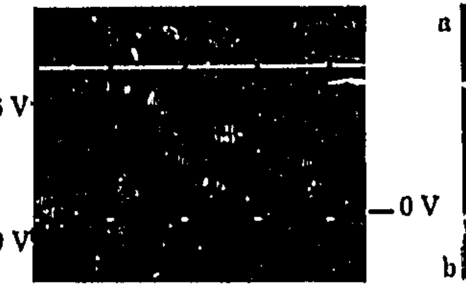
1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED: RESISTANCE IN OHMS; CAPACITANCE IN PICOFARADS;
3. ASTERISK (*) INDICATES SELECTED COMPONENT, AVERAGE VALUES SHOWN.
4. A6 BOARD WITH SERIES 1132A DOES NOT INCLUDE R44.

MORE DATA UNDER FOLD

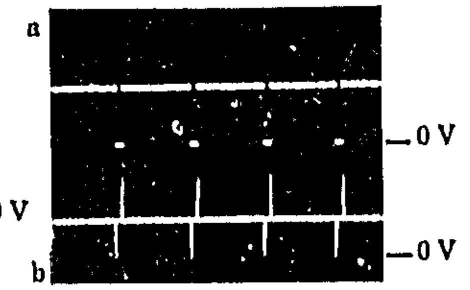




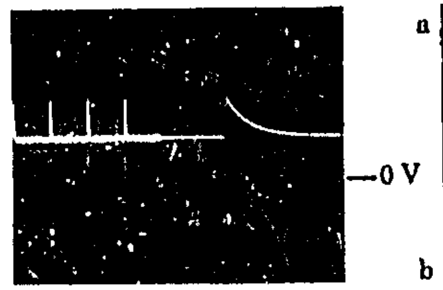
❶ a. U2(2)
b. U2(9)
.05 V/cm
SWEEP to MIXED
MAIN — .5 ms/cm
DELAYED — 50μs/cm



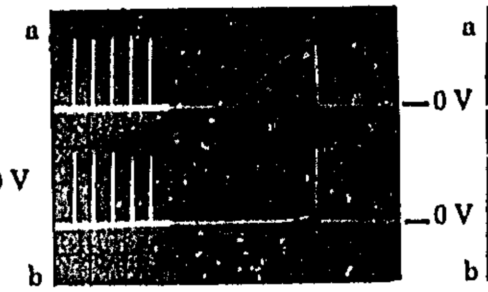
❷ .1 V/cm
.5 ms/cm



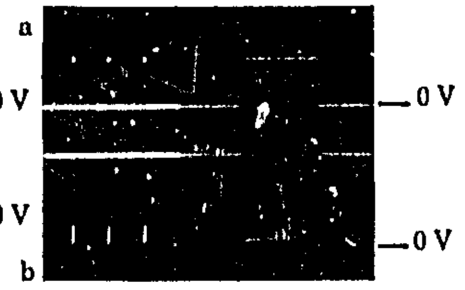
❸ a. U1(6)
b. U1(9)
.2 V/cm
.5 ms/cm



❹ .2 V/cm
SWEEP to MIXED
MAIN — 1 ms/cm
DELAYED — 10μs/cm



❺ a. Q7 — .1 V/cm
b. Q10 — .05 V/cm
SWEEP to MIXED
MAIN — 2 ms/cm
DELAYED — 20μs/cm



❻ a. U3(6)
b. Q11 collector
.2 V/cm
SWEEP to MIXED
MAIN — 1 ms/cm
DELAYED — 10μs/cm

All waveforms taken with 10:1 divider probe; ground lead is connected to ground side of C11. A6 is mounted on extender board.

OSCILLOSCOPE CONTROLS:
Use settings of A2 Assembly

DC VOLTAGES:
Set counter controls as stated.
Disconnect input signal.
Push RESET.

HE,LE — ECL levels
H,L — TTL levels

COUNTER CONTROLS:
Use settings of A2 Assembly

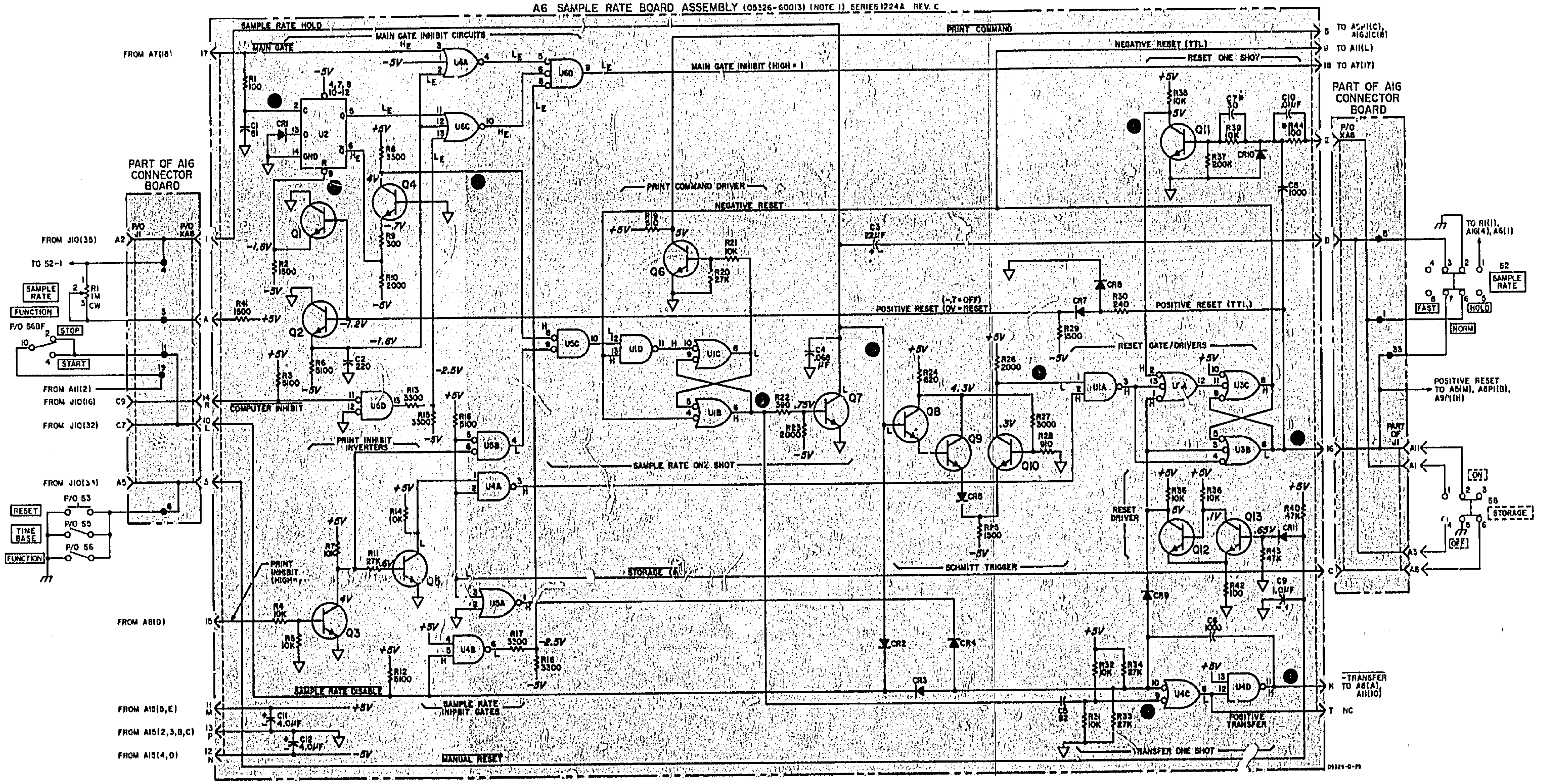


Figure 8-9. A6 Sample Rate Board Assembly

A7 FUNCTION CONTROL

Controlled by the front-panel FUNCTION switch, A7 directs the flow of the input, time-base output, and oscillator signals to the time-base decades (A5) and decade counter (A8). The scaled time-base signal ($\overline{OTB}$) returns to A7 and opens the main gate for a time determined by the setting of the TIME BASE/MULTIPLIER switch and the period of the time base input signal.

Frequency Measurement (A or B)

The INPUT A frequency enters on P1(J) and passes through an enabled U6F to U5B(5). This gate is also enabled, since the FUNCTION switch pulls only the FREQ line low. The input signal passes through U5D and U6D to U7B(8, 9). At the same time, the input signal, along with a low from U4C(10), sets the oscillator arming flip-flop, which places a high at U2(5). The next positive-going oscillator signal sets synchronizer U2 and allows the signal to pass through U1A and U5E to the base of Q1, which conducts, since U4C(10) is pulling Q2 base low. The time base input one-shot stretches the pulse width to about 50 ns before sending the signal to A5. The decade dividers on A5 scale the signal by a power of 10 and return it to A7 on P1(V). The main gate toggles with the first incoming negative pulse from the time-base dividers. The input frequency is then sent to the decade counters through U7B. The next time base output pulse toggles the main gate flip-flop closed, ending the measurement. The main gate inhibit line (from A6) goes high, locking closed U3A, resetting U2 and U1C&D, and turning off ITB (input to time base) gate by pulling Q2 base high.

Period Average

Period average measurements are similar to frequency measurements, except the input frequency is sent to the time-base dividers, and the oscillator signal is counted by the decade counters on A8 for subsequent display. The main gate is held open until A5 totals the number of periods selected with the MULTIPLIER switch.

Start

When totalizing the input signal, a high on U6(4) holds the main gate open (U3A set) as long as the FUNCTION switch is in the START position. The input signal is sent to the decade counters after being scaled by A5.

Check

When the CHK-NORM switch is in CHK, the oscillator signal ($\overline{OSCCH}$) substitutes for the Channel A amplifier output. The check line is high, allowing the oscillator square wave from U8C(13) to be differentiated by C1, R1, and R2. The negative-going pulses are sharpened by U4B and sent to A2 amplifier. These pulses return on A7P1(J) and are treated like any other amplifier signal in each of the above functions.

Levels

The incoming signals of A SIG, B SIG, check, and inhibit are ECL levels. All other input lines are TTL and are converted to ECL through translators. The output signals are ECL, except the $\overline{ITB}$, which is TTL.

A7 TROUBLESHOOTING

Before troubleshooting A7 Function Control, note the Trouble Isolation Table in Section V; also, the flow diagrams of the A7 schematic provide signal paths and logic levels for a specific mode. Assuming the input signals and control lines are operating properly, troubleshooting the circuit can be simplified if tested as follows:

NOTE

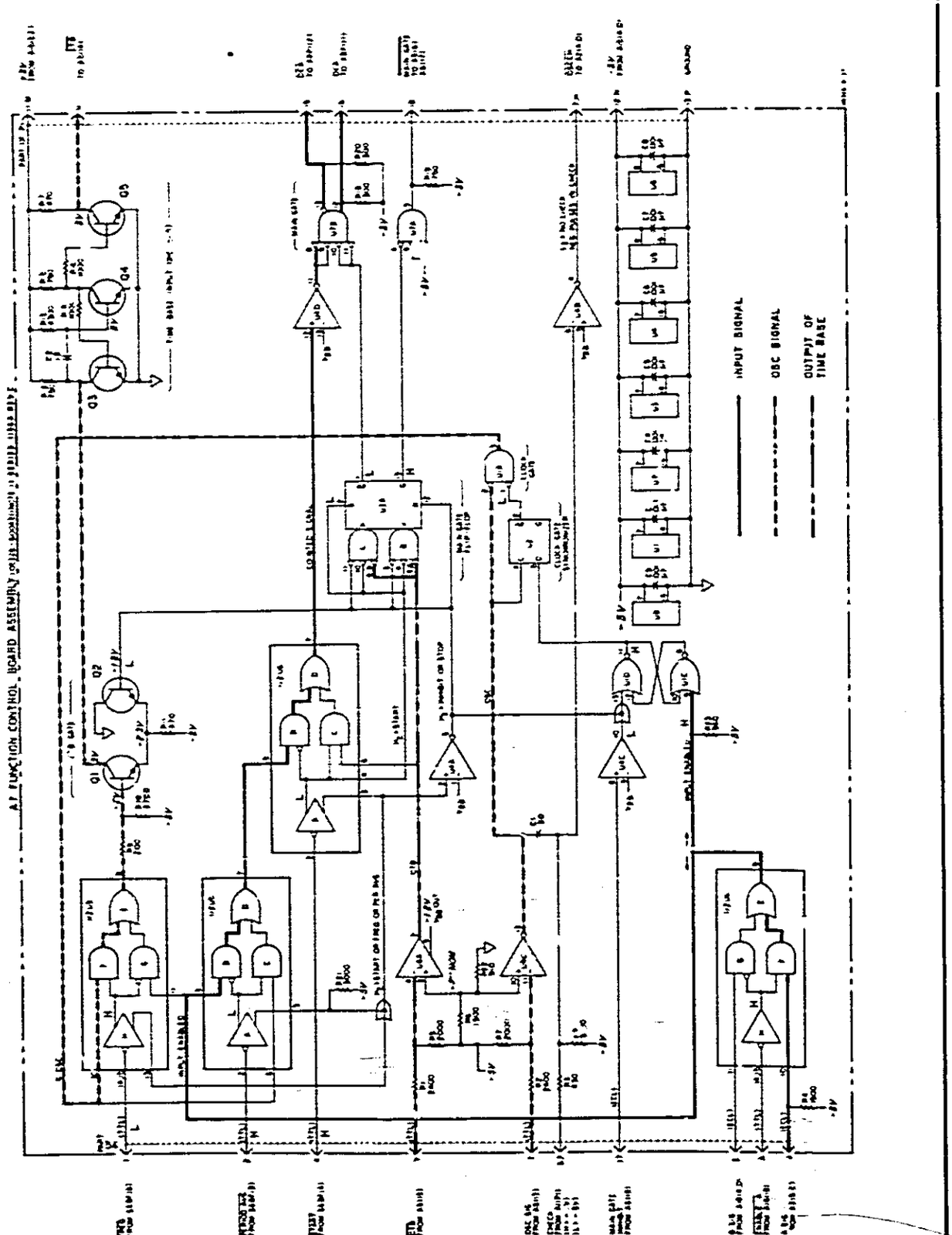
Set SAMPLE RATE switch to FAST and control full ccw. Use a 1 s gate time.

FREQUENCY	PERIOD AVERAGE	TOTALIZE
1. Check U4D(11) for counted signal	1. Check U4D(11) for gated oscillator signa	1. Check U5(9) for input signal.
2. Check U5(9) for gated oscillator signal	2. Check U5(9) for input signal.	2. Check A7(U) for $\overline{ITB}$ signal.
3. Check A7(U) for $\overline{ITB}$ signal.	3. Check A7(U) for $\overline{ITB}$ signal.	3. Check U4D(11) for counted signal.
4. Switch to fast gate time. Check that $\overline{OTB}$ signal has set Main Gate flip-flop U3A (pin 1=L, pin 13=H).	4. Switch to fast gate time. Check that $\overline{OTB}$ signal has set Main Gate flip-flop U3A (pin 1=L, pin 13=H).	4. Check that High on U3A(2) has set the flip-flop (pin 1=L, pin 13=H).
5. Check for gated count signal at U7B(13 and 12).	5. Check for gated count signal at U7B (13 and 12).	5. Check for gated count signal at U7B(13 and 12).

Figure 8-9
A6 SAMPLE RATE BOARD ASSEMBLY

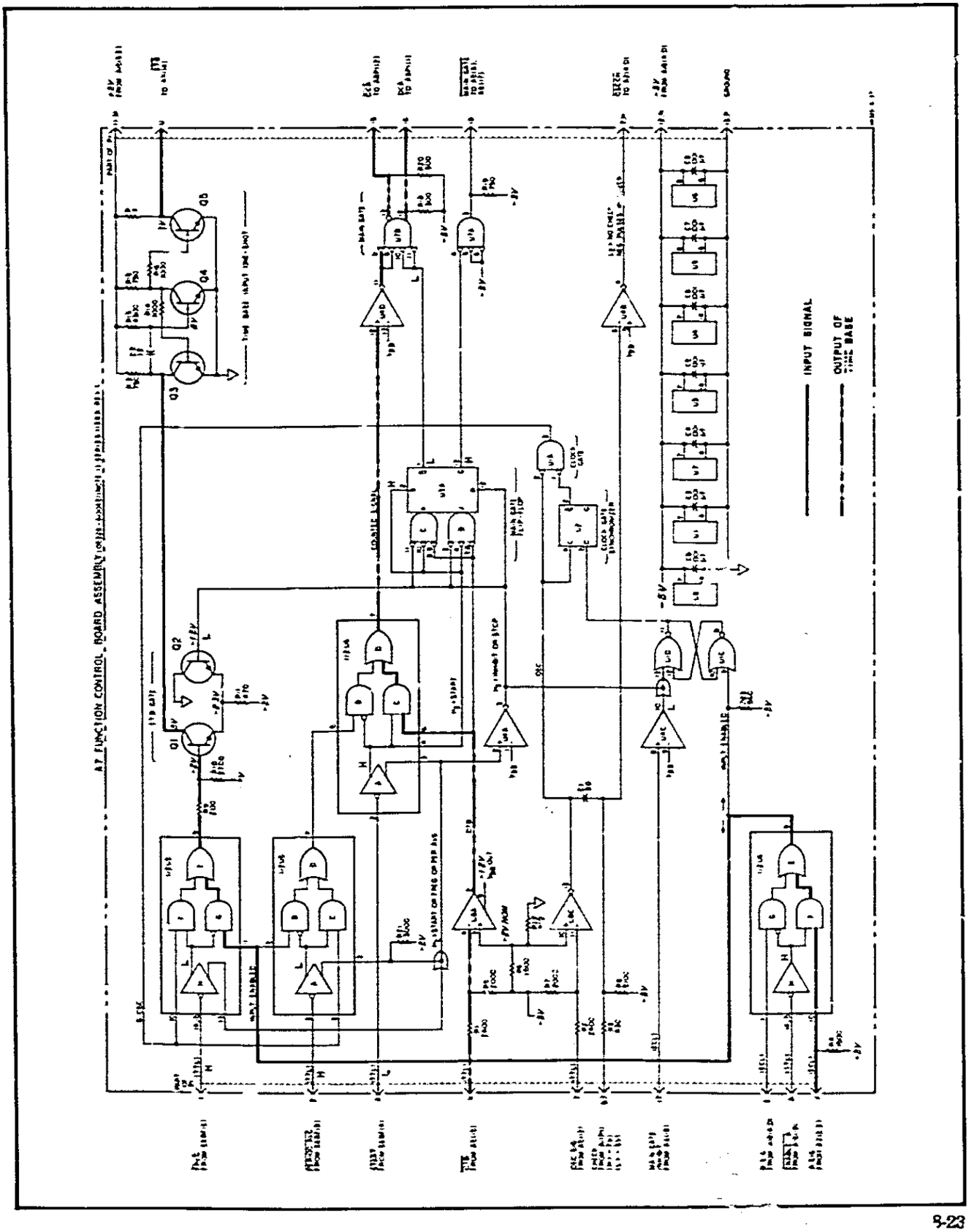
(See Page 8-21)

FREQUENCY

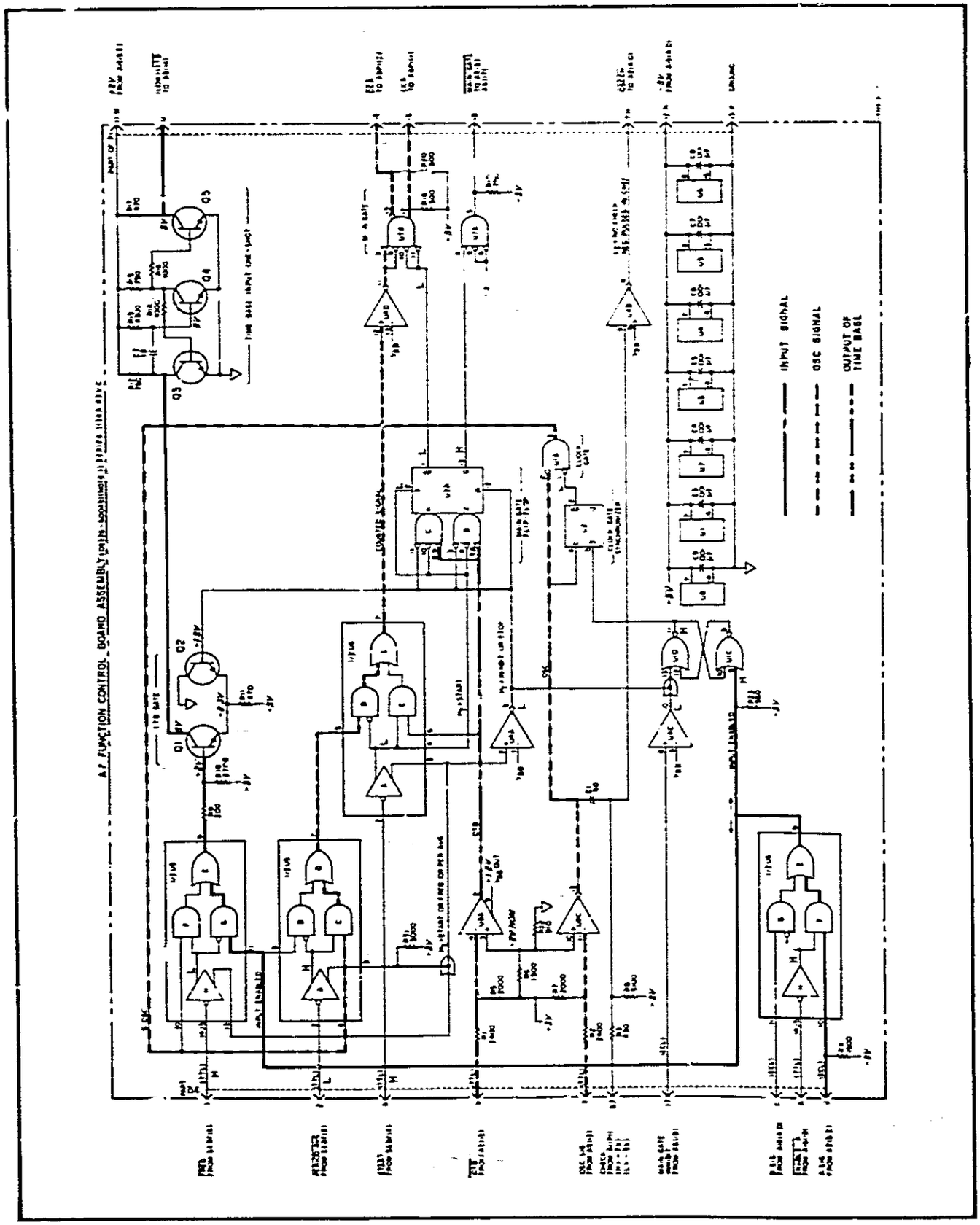


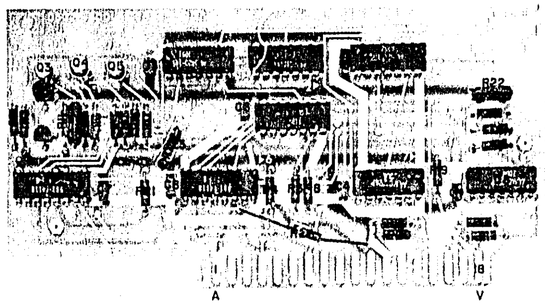
MORE DATA UNDER FOLD

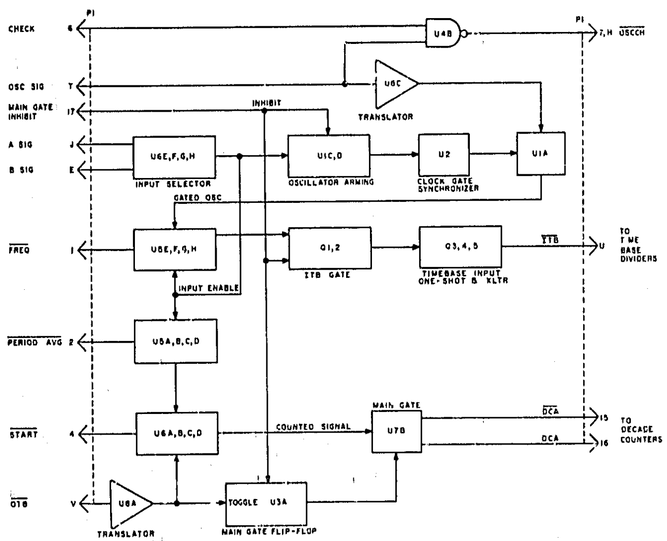
TOTALIZE

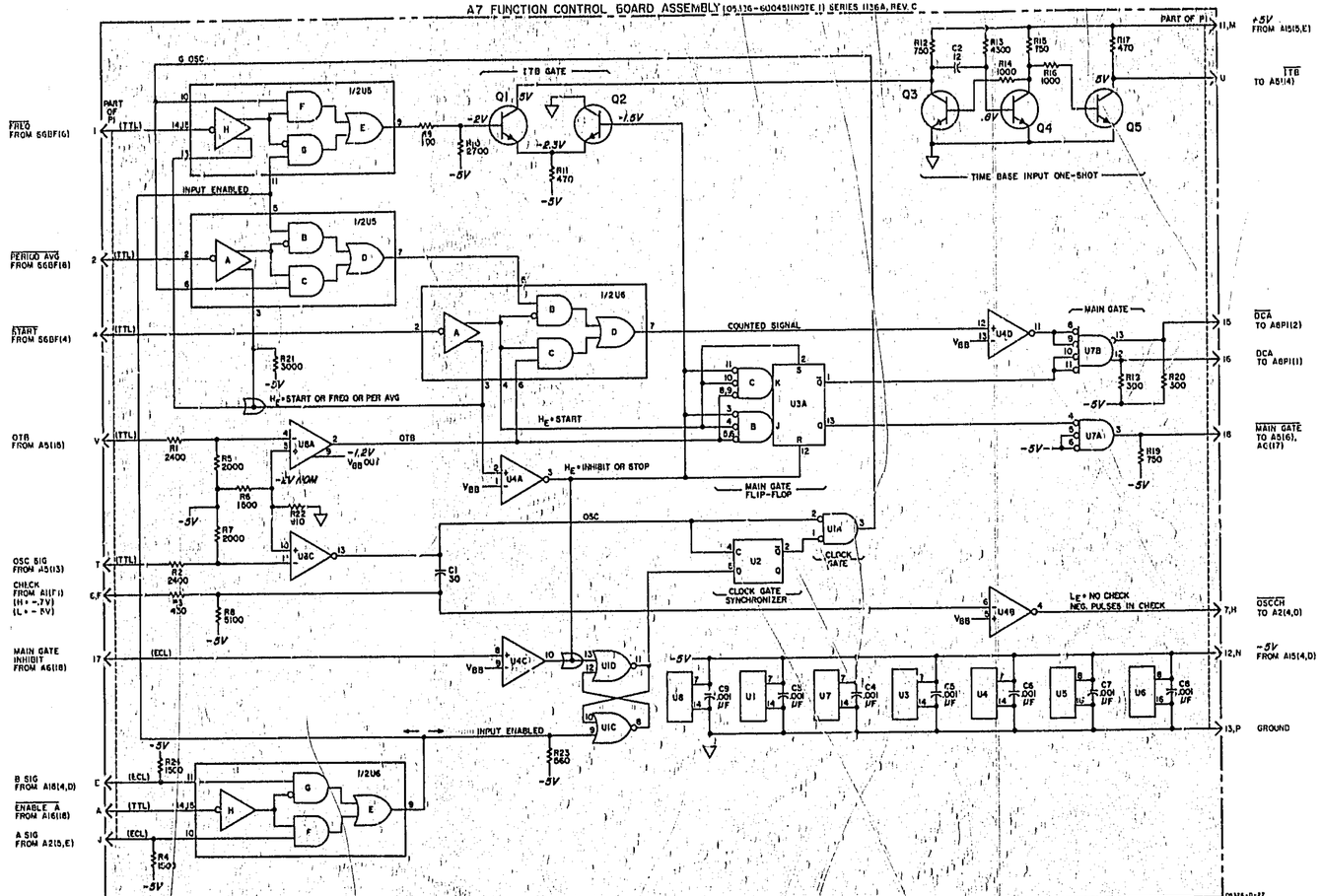

A7 FUNCTION CONTROL BOARD ASSEMBLY
INPUT SIGNAL
OUTPUT OF TIME BASE
Q1
Q2
Q3
Q4
Q5

PERIOD AVERAGE









NOTES

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED: RESISTANCE IN OHMS; CAPACITANCE IN PICOFARADS;

REFERENCE DESIGNATIONS

A7
C1-9
P1
Q1-5
R1-24
U1-8

TABLE OF ACTIVE COMPONENTS

REFERENCE DESIGNATIONS	HP PART NUMBERS
Q1,2	1854-0215
Q3,4,5	1854-0009
U1	1820-0145 MC1010
U2	1820-0440 MC1016
U3	1820-0102
U4	1820-0212 MC1020
U5,6	1820-0489
U7	1820-0252 MC1026
U8	1820-0253 MC1035

TRUTH TABLE

FUNCTION	GATE TOGGLE	DCA	ITB
FREQ	OTB	IE	G OSC
PER AVG	OTB	G OSC	IE
START	1	OTB	IE
STOP/ NONE	0	0	0

Figure 8-10. A7 Function Control Board Assembly

A8 DISPLAY SUPPORT OPERATION

The display support assembly A8 serves to interconnect the display assembly A9 with the interconnect assembly A16. In addition, A8 contains a high-speed decade counter, decimal point drivers, and blanking (logic) circuits.

The high-speed decade consists of four JK flip-flops U3 through U6. The line receiver, Q2 and Q9, serves to reduce noise levels on the signal from A7 prior to driving U3(6, 9). U3 divides by two and the combination of U4 through U6 divides by five. The decade supplies BCD outputs to A9 via J1(5, 4, 2, 3) for the 10^0 display tube. The D output is also used as the carry output to the next decade counter on A9. Q1 translates the positive TTL reset signal to ECL levels to reset the high-speed decade to zero.

Decimal point drivers Q3 through Q8 work in conjunction with logic circuits on A11 to light the proper decimal points. R15 and R17 provide operating bias for Q3 through Q8. R19, R20, and R23 are current limiters. R2 and R3 provide 87.5 volts pre-bias for the OFF decimal points. R5 through R10 connect the off decimals to the pre-bias voltage to eliminate background glow.

As an example of operation, when a ground is received at P1(S) from A11, Q5 conducts. With Q5 on, decimal point enable line 3 (DP3) is pulled to ground to light the decimal point on A9DS4(10^3). Also with P1(S) low, U1D(11) is high to unblank A9 U4. When U1D(11) goes high, U1B(6) and U1A(3) are also high to unblank A9U3 and U2. This unblanks A9DS4, DS3, and DS2. DS5 and DS6 remain blanked. DS1 is never blanked, and DS7 and DS8 (Option 001) will always be blanked.

CR2 and CR3 are included for use with the digital recorder Option 003. When overflow occurs, P1(M) and J1(15) go low. CR2 and CR3 cause J1(14 and R) to also go low. When J1(15, 14, R) are low, the recorder will print a zero on the annunciator line. R21 and R24 are pull-up resistors.

A8 TROUBLESHOOTING

High Speed Decade

If a problem in the High-Speed Decade is not readily apparent when checking for the correct waveforms, a step-through method may be preferable. Set the counter as follows:

1. MULTIPLIER switch to 10^7.
2. CHK/NORM switch to CHK.
3. FUNCTION switch to START.
4. Press RESET.

The High-Speed Decade has four output lines that are binary weighted DCBA . Release the RESET button and note the counter's display. A typical problem is as follows: The display counts 1...,2...,3...,0...,1...,2...,3...,0. When the display reads "0," set the FUNCTION switch to STOP and check the C line for a Low (refer to the table below). Check the input lines of the IC, since their levels depend on the state of other IC's in the circuit (note U4 pin 3 and U6 pin 13). The levels given below are ECL.

	A	B	C	D
DISPLAY	U3(13)	U4(1)	U5(1)	U6(1)
1	L	H	H	H
2	H	L	H	H
3	L	L	H	H
4	H	H	L	H
5	L	H	L	H
6	H	L	L	H
7	L	L	L	H
8	H	H	H	L
9	L	H	H	L
10	H	H	H	H
11	REPEATS			

Decimal Point and Blanking

Before testing the decimal point and blanking circuitry, set the CHK/NORM switch to NORM and disconnect the input signal.

DECIMAL POINT. To check the decimal point circuitry, set FUNCTION switch to PERIOD AVG and position the TIME BASE switch to pull the required D.P. line Low.

LINE	MULTIPLIER POSITION	DRIVER
D.P.0	1	Q8
D.P.1	10^1	Q7
D.P.2	10^2	Q6
D.P.3	10^6	Q5
D.P.4	10^7	Q4
D.P.5	10^8	Q3

BLANKING. To check the blanking circuitry, set the FUNCTION switch to PERIOD AVG and MULTIPLIER switch to 1. All digits, except the first one, should now be blanked. If another digit is lit, check that line at A8J1 for a High level, which indicates a problem on that line.

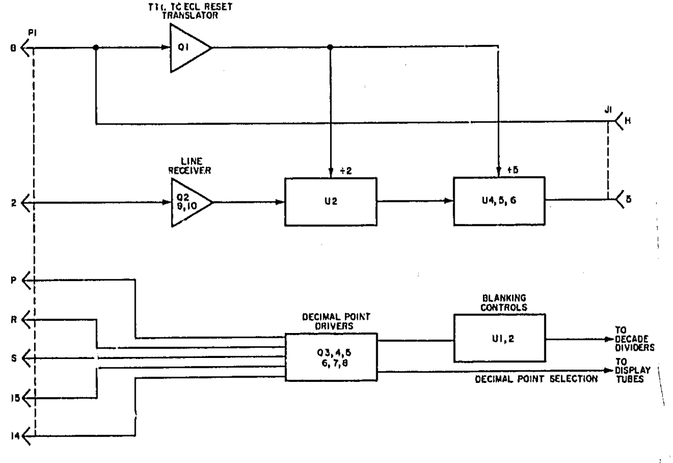
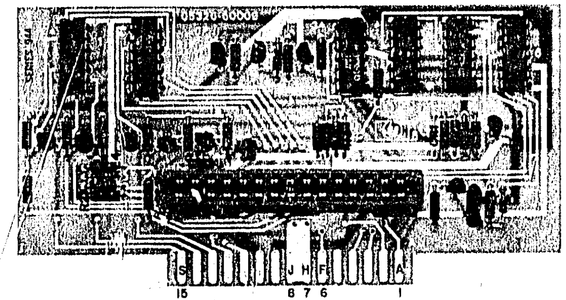
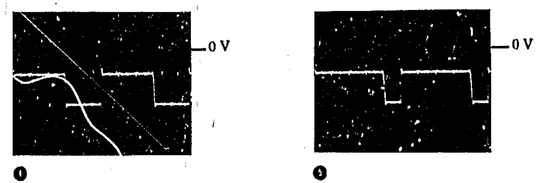


Figure 8-10
A7 FUNCTION CONTROL BOARD ASSEMBLY

(See Page 8-25)

MORE DATA UNDER FOLD





All waveforms taken with 10:1 divider probe; ground lead is connected to junction of R15, R3.

COUNTER CONTROLS:
Use settings of A2 Assembly

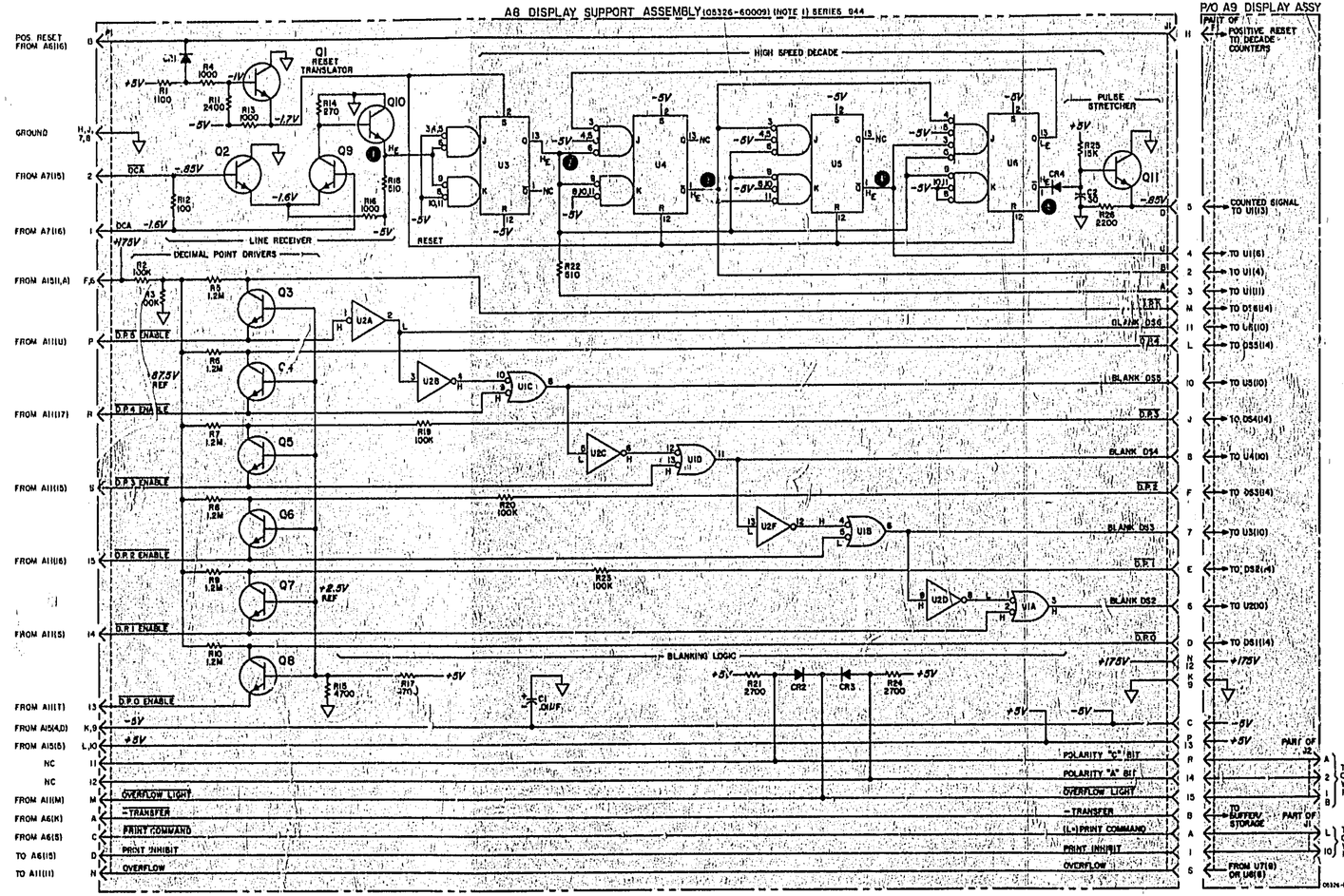
DC VOLTAGES:

Set counter controls as stated.
Disconnect input signal.
Push RESET.

HE,LE — ECL Levels
H,L — TTL Levels

OSCILLOSCOPE CONTROLS:

VOLTS/CM ..... .05 V/cm
TIME/CM ..... .2 μs/cm
SWEEP MODE ..... AUTO
TRIGGER ..... INT
SLOPE ..... +



NOTES

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED: RESISTANCE IN OHMS; CAPACITANCE IN PICOFARADS;

REFERENCE DESIGNATIONS

A6	A9
C1,2 CR1-4 J1 P1 Q1-11 R1-26 U1-6	J1,2 P1

TABLE OF ACTIVE COMPONENTS

REFERENCE DESIGNATIONS	HP PART NUMBERS
CR1,4	1901-0040
CR2,3	1910-0016
Q1,2,8-11	1854-0092 2N3563
Q3-6	1854-0365 2N4410
U1	1820-0094 MC846P
U2	1820-0307 MC836F
U3	1820-0143 MC1027
U4-6	1820-0102 MC1013P

Figure 8-11. A6 Display Support Assembly

A9 DISPLAY ASSEMBLY OPERATION

Display assembly A9 contains decade counters U2 through U7, buffer storage units U9 through U15, BCD to decimal converters U17 through U23, and display tubes DS1 though DS7.

U1 translates the ECL data from A8 into TTL levels for use by circuits on A9. Each translator of U1 is noninverting. The D output at U1(15) is the counted signal divided by 10 and is used as the input to 10^1 decade U2.

Decade counters U2 through U7 count the number of input pulses while the main gate is open. Each decade provides a 8421 BCD output to the corresponding buffer storage unit. When pin 14 (reset) goes High, the decades reset to zero if pin 10 is High; the decades reset to 15 (blank) if pin 10 is Low. The ECL decade on A8 never blanks. U7 and U6 (Option 001) always blank. The last decade supplies an overflow output at pin 8 when the count exceeds the capacity.

Buffer storage units U9 through U15 receive the BCD outputs of the decades. When the counter operates in the storage-on mode, data is transferred when a low transfer pulse arrives at pin 5 of the buffers. When the transfer line is high, the buffers will store the data to allow a continuous display while a new measurement is being made. During storage-off or totalize mode, BCD data is continuously fed from the buffers to the decoders. The buffers also supply 8421 BCD outputs to A9 J1 and J2 for further distribution to J9 when Option 003 is included.

Decoder drivers U17 through U23 receive the 8421 BCD data and provide a decoded decimal output to light the corresponding numeral on the display tube. The terminal for an illuminated numeral will be approximately +2 volts whereas an extinguished numeral is typically +100 volts. The decimal point terminal (14) of the display tube is <5 volts when lit and about 87.5 volts when extinguished.

A9 TROUBLESHOOTING

The A9 Display Assembly may be set up for troubleshooting with either of two methods. A highly accurate oscillator may be used for a front-panel input signal. Any difference in count from the input signal is then immediately obvious on the display. Check for the proper signal division of the decade counter in previous column. As an alternate method, place the CHK/NORM switch in CHK and the FUNCTION switch in START. Allow the count to totalize until the problem occurs; then, set the FUNCTION switch to STOP. Use the TIME BASE switch to adjust the rate of counting. When the problem appears, check the circuitry of that column.

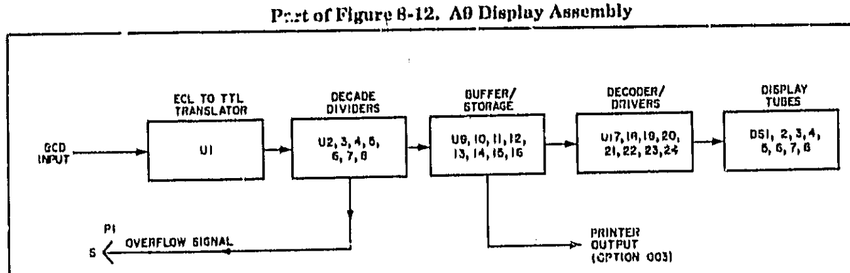
Start by checking the Buffer-Storage outputs (U9-U15) for the BCD code of the number that should be displayed, rather than what is displayed (see Table 1). Check that the Buffer-Storage code pulls the proper decimal line low on the BCD-to-Decimal Decoder.

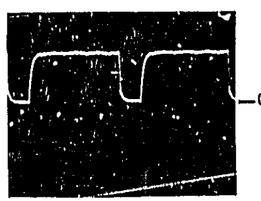
Table 1

DISPLAYED DIGIT	BUFFER STORAGE BCD (TTL)			
	8	4	2	1
0	H	H	H	H
1	H	H	H	L
2	H	H	L	H
3	H	H	L	L
4	H	L	H	H
5	H	L	H	L
6	H	L	L	H
7	H	L	L	L
8	L	H	H	H
9	L	H	H	L
Blank	L	L	L	L

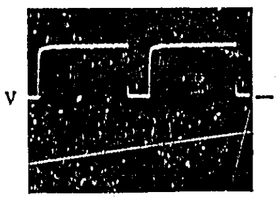
Figure 8-11
A8 DISPLAY SUPPORT ASSEMBLY
(See Page 8-27)

Part of Figure 8-12. A9 Display Assembly

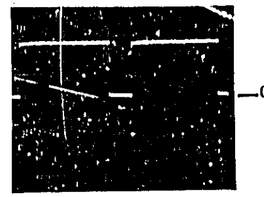




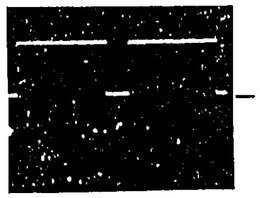
U1(15)
.2 V/cm
.2 μs/cm



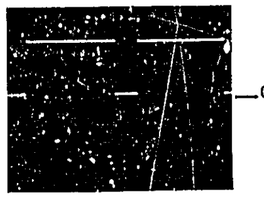
U2(8)
.2 V/cm
2 μs/cm



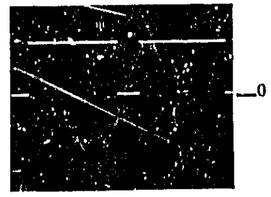
U3(8)
.2 V/cm
20 μs/cm



U4(8)
.2 V/cm
.2 ms/cm



U5(8)
.2 V/cm
2 ms/cm



U6(8)
.2 V/cm
20 ms/cm

All waveforms dc coupled through 10:1 probe. Center line of graticule is zero volts. Triggering is internal ac.

COUNTER CONTROLS:

FUNCTION ..... START
MULTIPLIER 1
CHK/NORM ..... CHK

MORE DATA UNDER FOLD

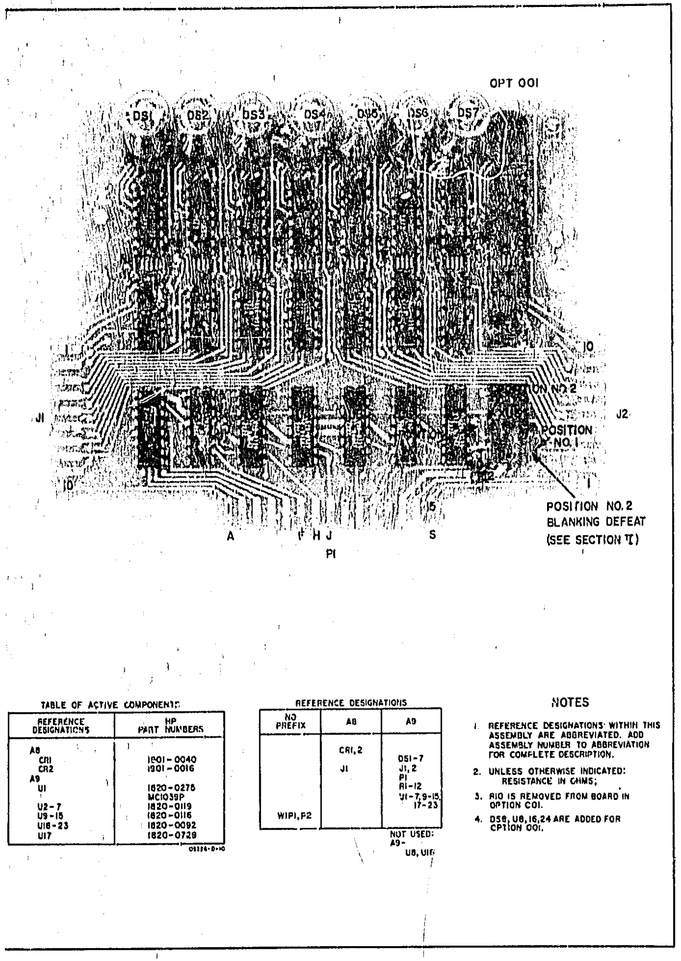


TABLE OF ACTIVE COMPONENTS

REFERENCE DESIGNATIONS	HP PART NUMBERS
A9	
CR1	1901-0040
CR2	1901-0016
A9	
U1	1820-0275
	MC1039P
U2-7	1820-0119
U9-15	1820-0116
U16-23	1820-0092
U17	1820-0729

05326-D-10

REFERENCE DESIGNATIONS

NO PREFIX	A8	A9
	CR1,2	DS1-7
	J1	J1,2
		P1
		R1-12
		U1-7,9-15, 17-23
WIP1,P2		

NOT USED:
A9 - U8, U16

NOTES

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED: RESISTANCE IN OHMS;
3. R10 IS REMOVED FROM BOARD IN OPTION C01.
4. DS8, U8, 16, 24 ARE ADDED FOR OPTION C01.

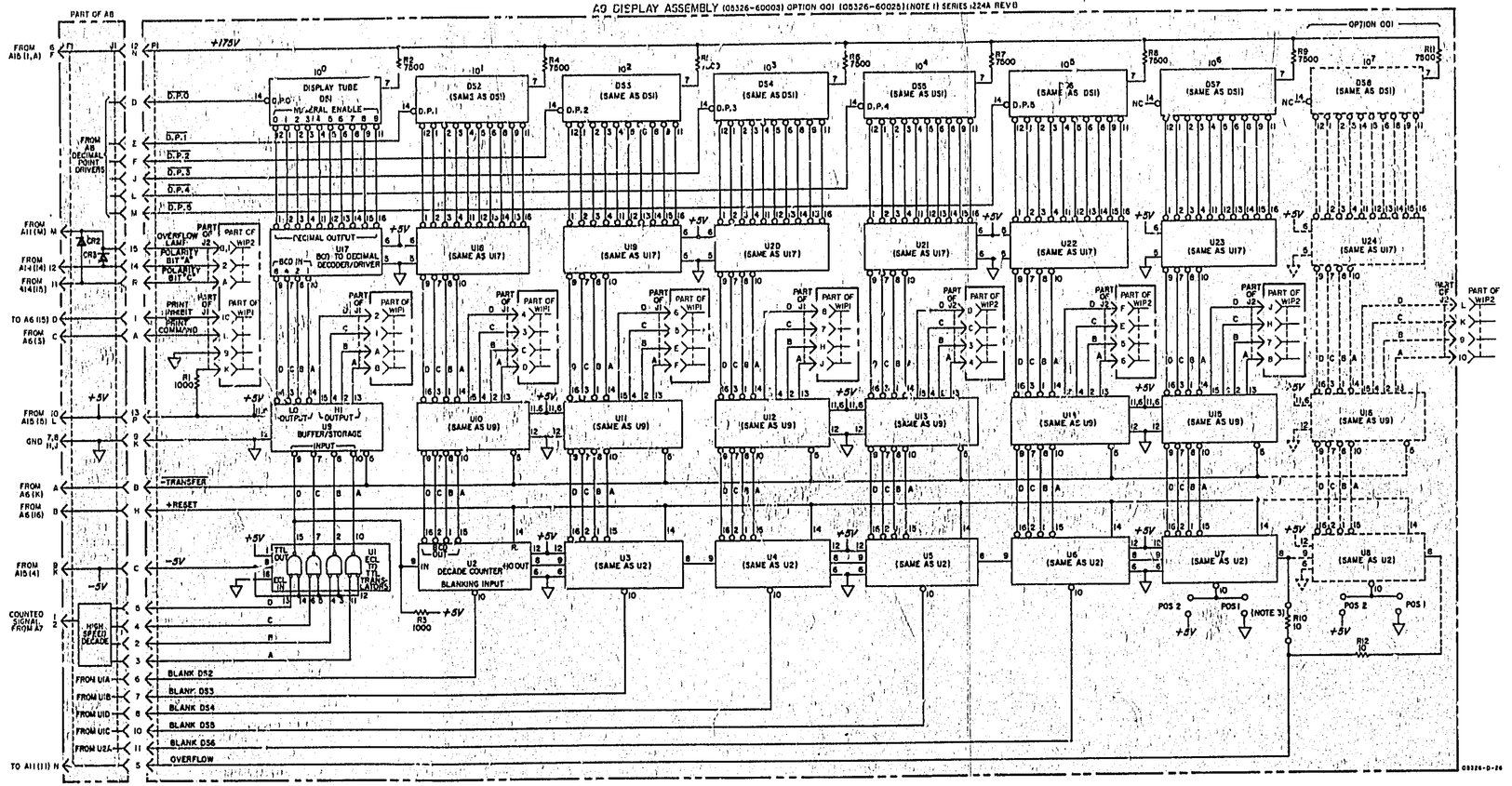


Figure 8-12. A9 Display Assembly

A10 RIGHT READOUT OPERATION

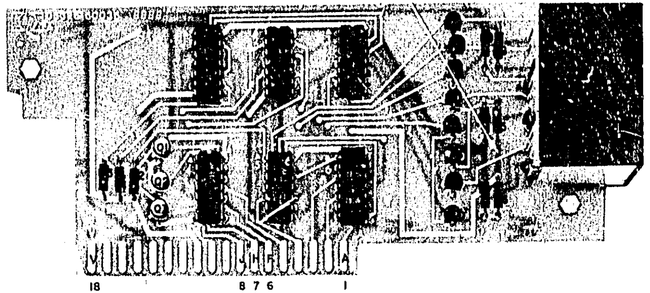
The right readout contains DTL logic to provide the proper measurement units for a given setting of the front-panel controls. A10 logic is negative true, and a low (0.8 volt) to the emitter of any driver transistor will light the given neon. When a DTL high is applied on the emitters, the transistor reverse biases to turn off the neon lamps. The voltage dividers provide a reference of 1 V (nominal) to the bases of the drivers.

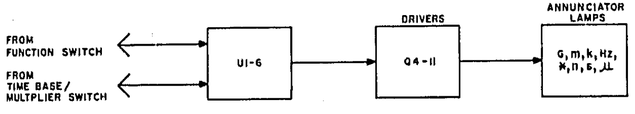
Selecting a function mode and time b[illegible] pulls a pair of these lines low, activating a gate. Th[illegible] low on the gate output will forward bias the driver transistor to turn on the annunciator lamp. For example, selection of frequency and 1 ms makes the output of U2B(6) low, turning on Q5 to light DS2. U3B(6) is also low, lighting DS4.

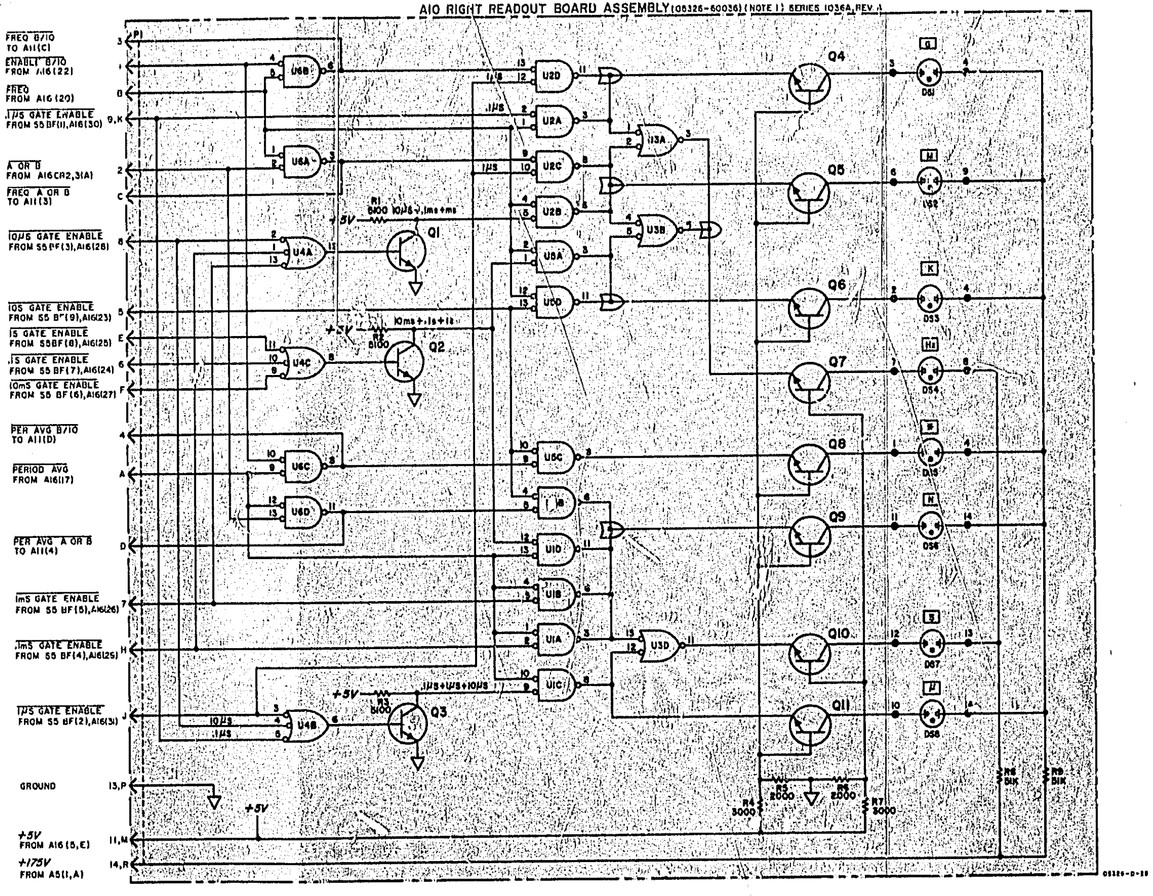
The asterisk (*) annunciator is activated for the 5327C model only. This occurs when the instrument is in PERIOD AVG, B+10, and 10 s gate time. An asterisk indicates the proper units are not displayed.

A10 TROUBLESHOOTING

If one of the annunciator lights does not work, set the front panel switches to the positions that would normally cause the lamp to be on. Refer to the tables in Figure 3-3 for the appropriate switch settings. Check the gates whose input lines correspond to the switch settings. As an example, the G lamp lights under either one of two conditions: U2D and U6B are activated when the 1 μs $\overline{\text{GATE ENABLE}}$, $\overline{\text{FREQ}}$, and $\overline{\text{ENABLE B+10}}$ lines are pulled low, or U2A is activated when the .1 μs $\overline{\text{GATE ENABLE}}$ and $\overline{\text{FREQ}}$ lines are pulled low.







NOTES

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED: RESISTANCE IN OHMS; CAPACITANCE IN PICOFARADS;

REFERENCE DESIGNATIONS

A10
DS1-8 P1 Q1-11 R1-9 U1-6

TABLE OF ACTIVE COMPONENTS

REFERENCE DESIGNATIONS	HP PART NUMBERS
Q1-3	1854-0009 2N709
Q4-11	1854-0474 2N5551
U1,2,5,6	1820-J274 MC1606
U3	1820-0273 MC1806
U4	1820-0310 MC862

Figure 8-13. A10 Right Readout Board Assembly

A11 LEFT READOUT OPERATION

The left readout contains DTL logic to select the proper decimal point corresponding to the front panel settings. It also contains the switch common drivers for the time base, function, and amplifier common lines (for remote programming), a storage circuit and lamp for the overflow signal, gate light, and EXT light.

The overflow signal from the divide-by-ten output of A8U7, (U8, Option 001) enters through pin 11 and is differentiated by C3 and R2. Q1 turns on momentarily to set flip U9A&D. During the transfer pulse, the information at U9A&D is transferred to the overflow storage flip-flop U9B&C. The overflow condition drives U9B(6) low to turn Q2 on and light overflow lamp DS1. The next reset pulse clears flip-flop U9A&D; however, U9B&C are not reset until the transfer pulse arrives. With storage off, transfer is on continuously.

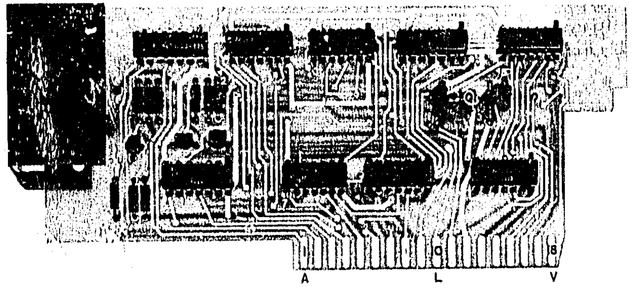
A low at pin 9 turns on Q3 to light the gate lamp, DS2. Similarly, a low at pin A lights the EXT lamp and opens the common lines for the TIME BASE, FUNCTION, and SLOPE switches. This disables these controls to allow remote programming of the unit.

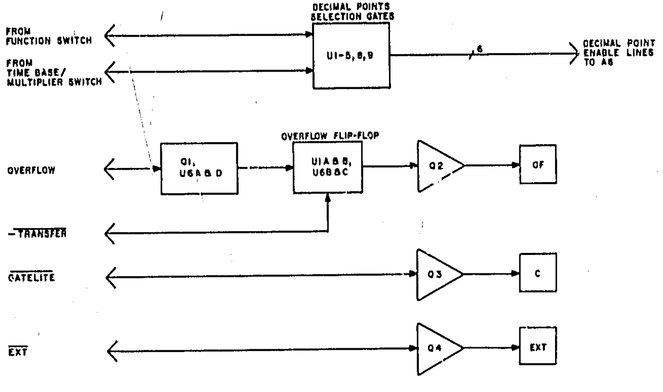
A11 TROUBLESHOOTING

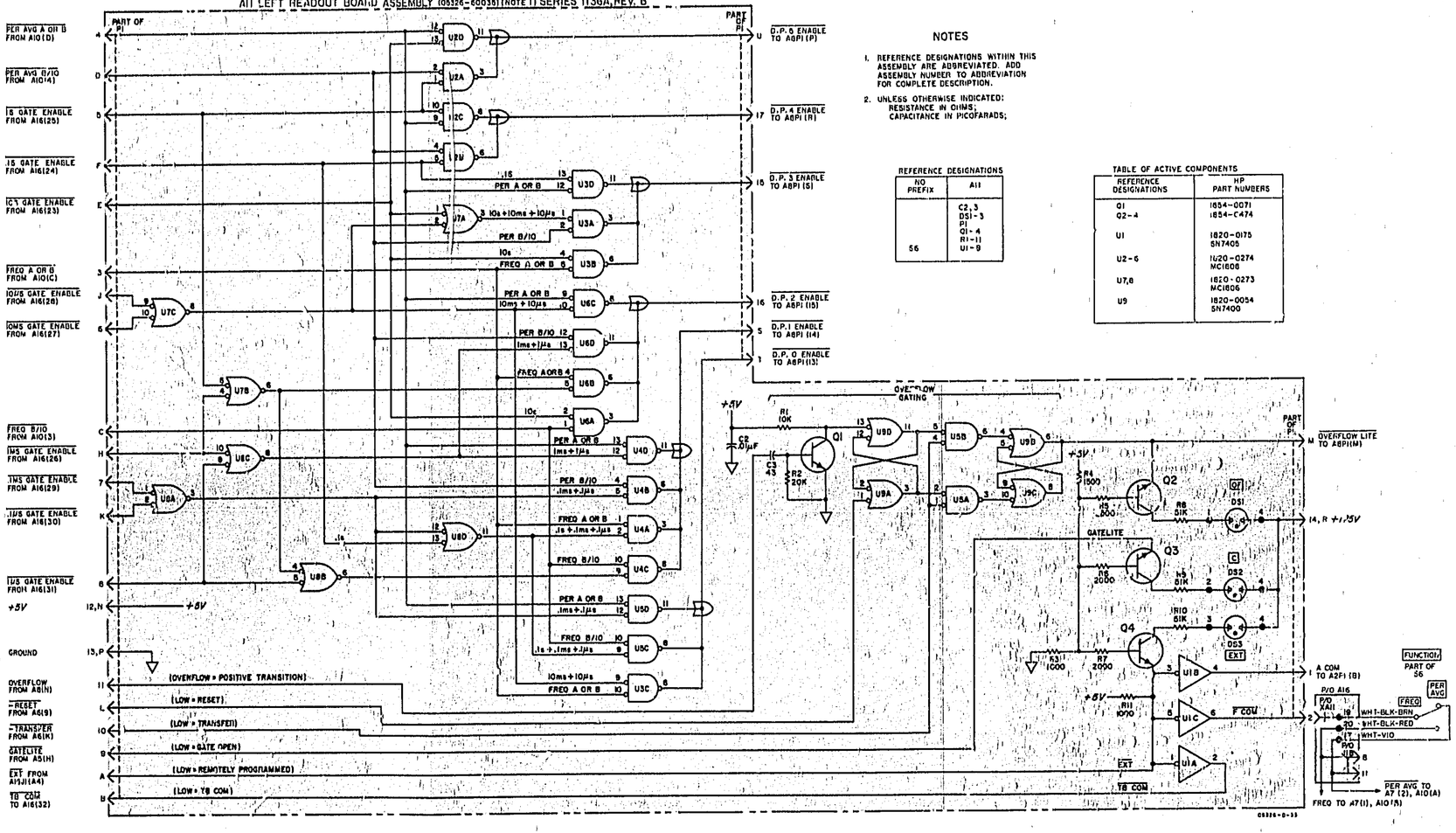
If one of the decimal lights does not work, set the front panel switches to the positions that would normally cause the lamp to be on. Refer to the tables in Figure 3-3 for the appropriate switch settings. Check the gates whose input lines correspond to the switch settings. As an example, the $\overline{\text{D.P.5 ENABLE}}$ line goes low under either one of two conditions: U2A is activated when the $\overline{\text{PER B+10}}$ and $\overline{\text{1 s GATE ENABLE}}$, and U2D is activated when the $\overline{\text{PER A OR B}}$ and $\overline{\text{10 s GATE ENABLE}}$ lines are pulled Low.

To check the overflow circuits, set the FUNCTION switch to START and select a fast gate time. When the most significant digit on the counter's display changes from 9 to 0, both flip-flops in the overflow circuit should set. An an initial test, check U5 for a High on pin 5. The second flip-flop (U9B & U9C) should have a Low on pin 6 and a High on pin 8.

In a frequency or period average measurement, the $\overline{\text{-TRANSFER}}$ line pulses Low, rather than being held Low as in START. If the OF light does not turn off at the end of the display time, check that the $\overline{\text{-RESET}}$ pulse clears flip-flop U9A and D.







NOTES

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED: RESISTANCE IN OHMS; CAPACITANCE IN PICOFARADS;

REFERENCE DESIGNATIONS

NO PREFIX	A11
	C2, 3 DS1-3 P1 Q1-4 R1-11 U1-9
56	

TABLE OF ACTIVE COMPONENTS

REFERENCE DESIGNATIONS	HP PART NUMBERS
Q1	1854-0071
Q2-4	1854-0474
U1	1820-0175 SN7405
U2-6	1820-0274 MC1606
U7,8	1820-0273 MC1606
U9	1820-0054 SN7400

Figure 8-14. A11 Left Readout Board Assembly

A15-A16 POWER SUPPLY OPERATION

The power supply provides +175, +16.5 V and +5 V. Transformer T1 has a 115/220 primary and secondaries with open circuit voltages of 181 V at the red leads, 21 V at the orange, and 18.6 V between the green leads, with the winding center tapped to ground.

A15 CR6-9 comprise a full-wave bridge whose output is fed to filter C3 and bleeder R3. Q5 is a series pass regulator. A constant reference voltage is developed across CR11 and CR12 through resistor R1. When the output voltage at XA15(1, A) decreases, Q5 increases conduction to increase the output voltage. Q8 is a current limiter that senses the voltage drop across R6. Output current above approximately 60 mA turns on Q8 and shunts base current from Q5, tending to turn Q5 off and limit the current. C1 adds oscillation stability to the regulator.

For the +16.5 V supplies, the orange leads of T1 connect to half wave rectifier CR4 and filter C4. Q1 is a series pass regulator and Q9 performs the same function as CR11&CR12 in the 175 V supply except that R10 provides a means to adjust the output. Assume that a Q1 base current is flowing through R2 and Q6. The resulting Q1 collector current establishes a voltage at the output, which is divided across R9, R10, and R11. If the voltage at the wiper of R10 is greater than that across CR9, Q9 will be turned on, shunting base current from Q1. This will tend to turn off Q1 and lower the regulated voltage. Thus, varying R10 establishes the largest output voltage that can exist before Q9 turns on to cut back Q1. Resistors R17, R18, and diodes CR15-18 provide current limit action at 180 mA similar to the +175 V supply.

Q6 is a preregulator that gives the circuit better line regulation and lower ripple than the Zener diodes of the 175 V supply. With CR1 as a reference, Q6 is a constant current circuit that maintains a Q1 base current independent of variations of the input (line voltage changes and ripple). R4 is needed to establish the current through CR1. The -16.5 V supply is complementary. The 5 V supplies are also complementary and only the + will be discussed.

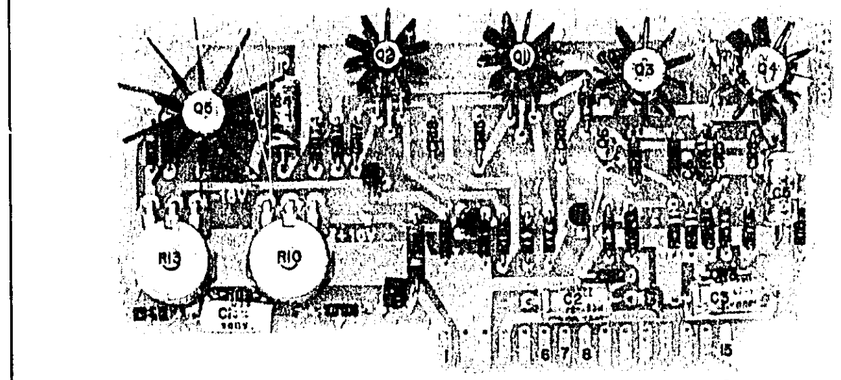
The output from the T1 green leads is fed through full wave rectifier CR10 and CR11 into filter C1. It then passes through overload current limiter R1 and into the series pass regulator Q1, to the 5 V output at Q1C. Q3 is a driver for Q1 and has approximately 5.75 V on its base, developed across CR6 and CR5 by the current from the 16.5 V supply through R7. If the voltage at the emitter 5.1 V, Q3 is turned on providing base current to turn on Q1, raising the output voltage. Q3 turns off when its emitter gets above 5.1 V. C2 is the output filter to maintain a low output impedance at high frequencies.

CR2 clamps the output at 6 V to provide protection for the IC's in case the 16.5 V or 175 V line should momentarily short to the 5 V line. CR5 provides thermal compensation for Q3.

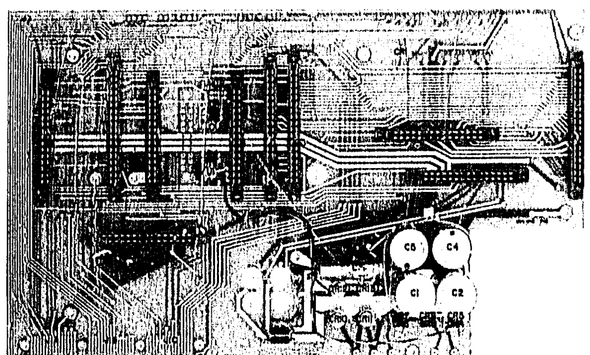
Note that the 16.5 V supply is needed for operation of the 5 V supply. If the + or - 16.5 V supply fails, the corresponding 5 V supply will be inoperative.

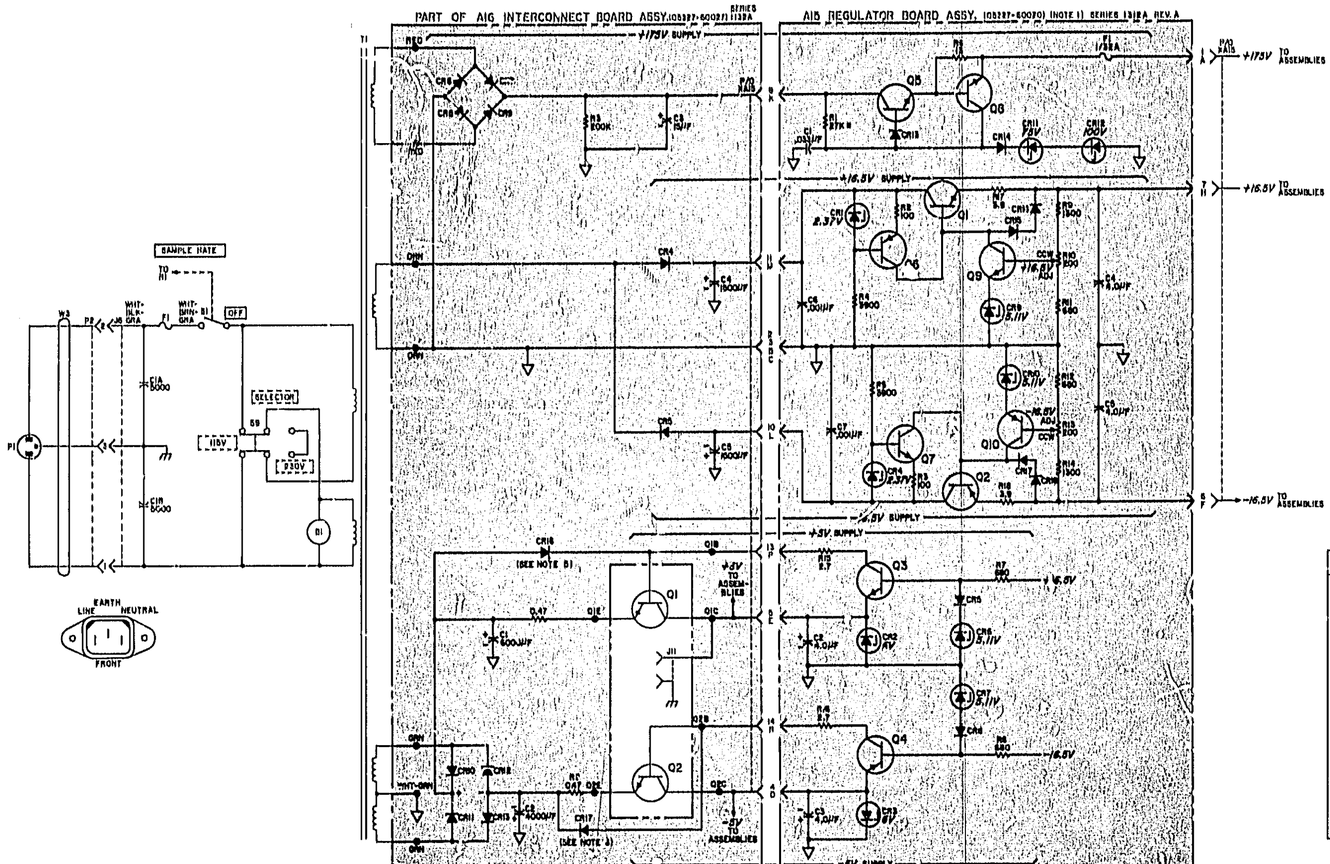
Figure 8-14
A11 LEFT READOUT BOARD ASSEMBLY
(See Page 8-33)

Part of Figure 8-15. A15, A16 Regulator/Interconnect Board Assembly



MORE DATA UNDER FOLD





NOTES

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED: RESISTANCE IN OHMS; CAPACITANCE IN MICROFARADS.
3. A15 Q1-5 HAVE HEAT SINK.
4. ASTERISK (*) INDICATES SELECTED COMPONENT, AVERAGE VALUES SHOWN.
5. CR16 AND CR17 ARE 3-JUNCTION SILICON DIODES.

REFERENCE DESIGNATIONS

NO PREFIX	A15	A16
B1		
C1	C1-7	C1-5
	CR1-18	CR4-13, 16,17
F1		
J8, J11	F1	
P2		
Q1, 2	Q1-10	
	R1-18	R1-3
S1, 9		
T1		
W3		

TABLE OF ACTIVE COMPONENTS

REFERENCE DESIGNATIONS	HP PART NUMBERS
NO PREFIX	
Q1	1853-0233
Q2	1854-0420
A16	
CR1, 4	1902-3002
CR2,3	1902-0551
CR5,6,15-18	1901-0040
CR6,7,9,10	1902-3084
CR11	1902-3384
CR12	1902-3429
CR13,14	1901-0033
Q1	1854-0300
Q2	1853-0073
Q3	1854-0039
	2N3053
Q4	1853-0012
	2N2604A
Q5	1854-0232
Q6,10	1853-0020
Q7,9	1854-0071
Q8	1854-0474
A15	
CR4,5	1901-0045
CR6-9	1901-0028
CR10-13	1901-0415
CR16,17	1901-0460

Figure 8-15. A15, A16 Regulator/Interconnect Board Assembly

A16 PRESCALER OPERATION

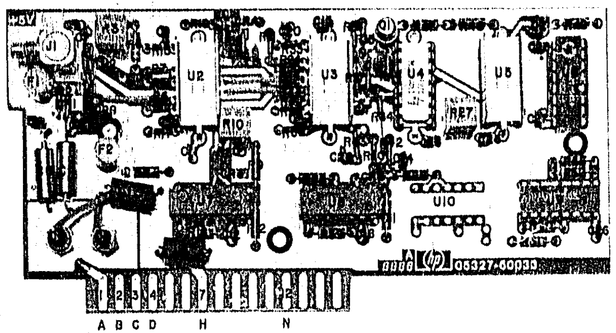
The prescaler board serves as a direct amplifier-trigger or as a divide-by-ten amplifier with the function controlled by the front-panel INPUT SELECTOR switch. With the switch in the B÷10 position, the circuit performs as follows:

The signal is fed into the 50Ω input of J1. CR1, CR2, and U1 provide protection above 3.5 V rms or 5 V peak. There is about 2 dB loss through U1. The signal is passed to U2 amplifier, which is biased for sensitivity by R3. U3 amplifies the differential input and shapes the signal into a square wave. U4 and U5 combine to divide the signal by ten and Q2 translates the signal from EECL to ECL levels before presenting it to the data switch.

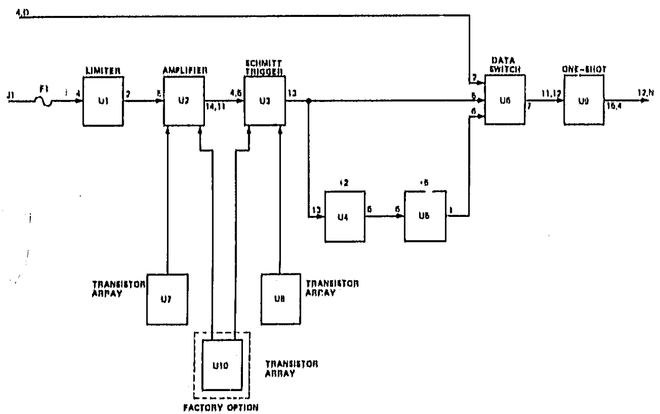
The direct signal, also from U3(13), bypasses the divider network and is sent to the data switch through the level translator Q1. The setting of the INPUT SELECTOR switch determines whether the data switch will accept the direct or prescaled signal. Pin 2 of U6 is High for direct and Low for prescaled. U9 shapes the positive, square-shaped pulses into narrow spikes before sending the signal to A7 Function board. U7, U8, and U10 (a production option) are constant-current sources for the amplifier circuits.

A16 TROUBLESHOOTING

Before troubleshooting the circuits, check the input protection fuse. If problem is in direct mode only, check Q1 and U6. If problem is in prescale mode only, check U4, U5, and U6, and Q2. If a problem is found in the amplifiers (U2 and U3), remove the input signal and check the dc voltages supplied by the constant-current sources U7 and U8.



BLOCK DIAGRAM 05327-60033 HIGH SENSITIVITY PRESCALER BOARD



A18 HIGH SENSITIVITY PRESCALER ASSEMBLY (05327-60033) SERIES 1248

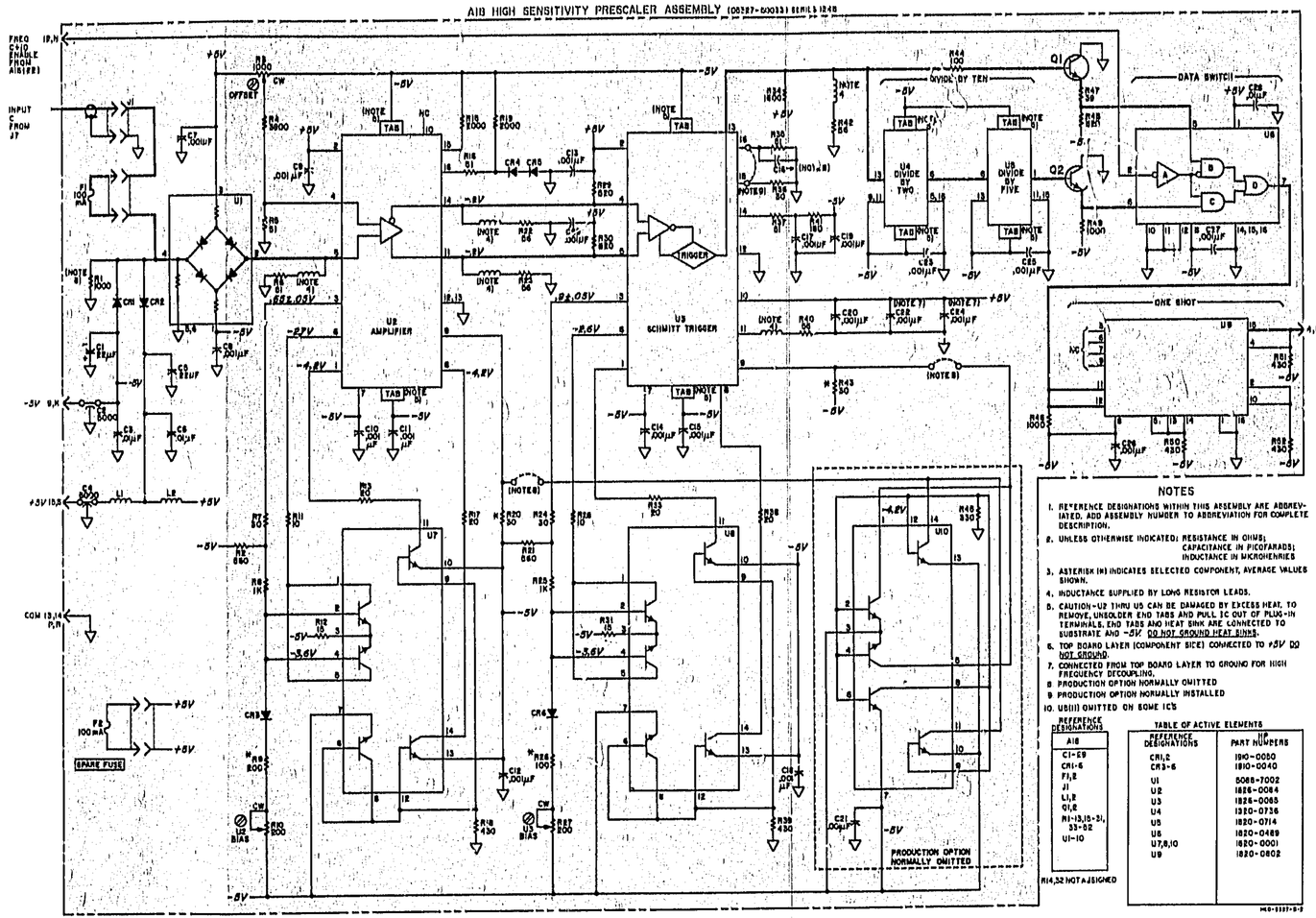
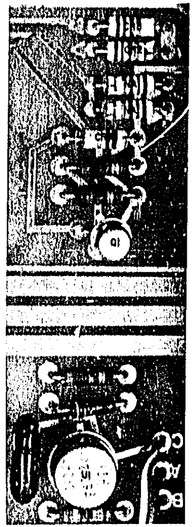


Figure 8-16. A18 High Sensitivity Prescaler Assembly



OPTIONS 010 AND 011 A16 INTERCONNECT CIRCUIT BOARD (PARTIAL DIAGRAM) (05327-60026/27/28) SERIES 1224A

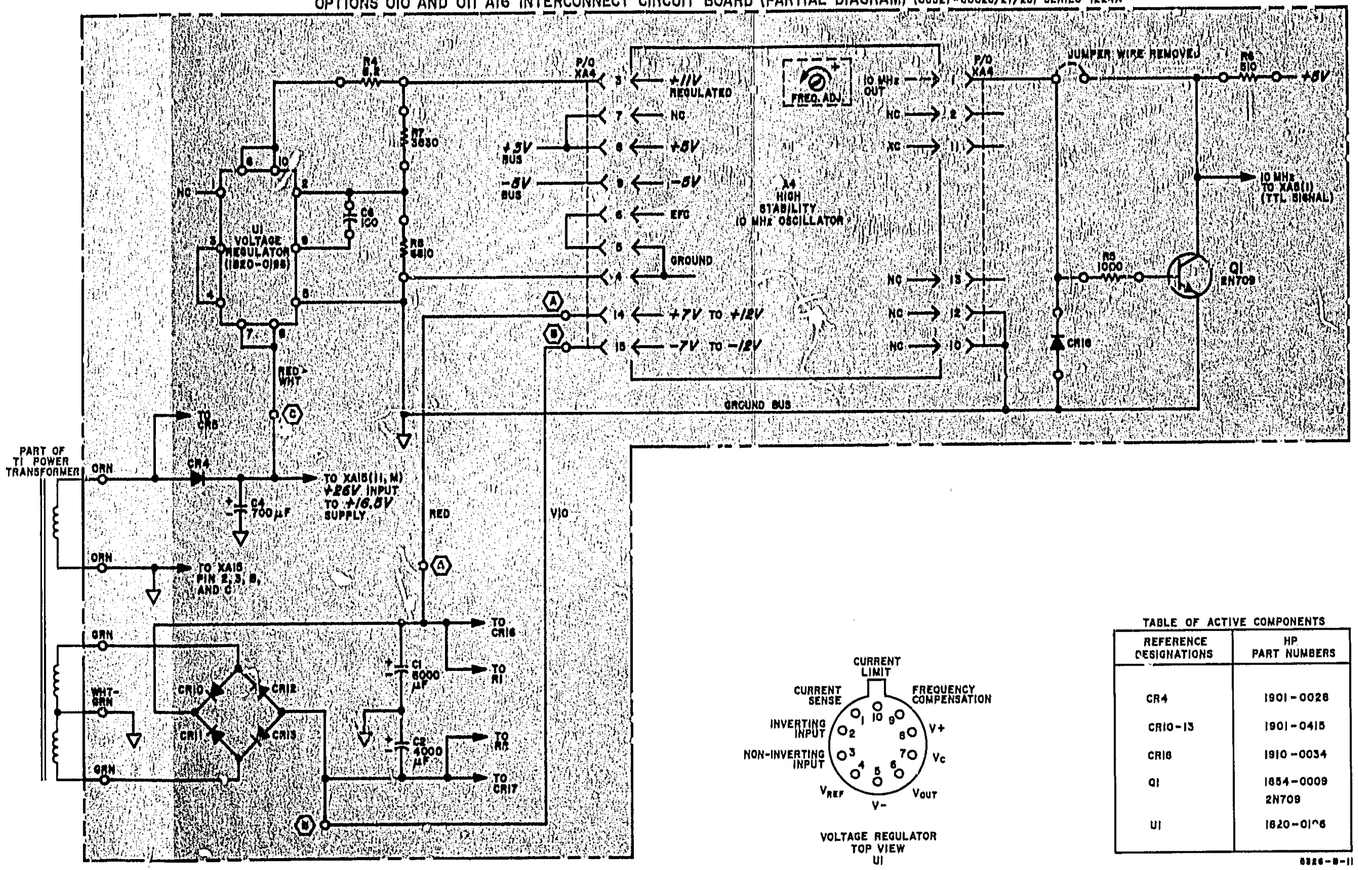


TABLE OF ACTIVE COMPONENTS

REFERENCE DESIGNATIONS	HP PART NUMBERS
CR4	1901-0028
CR10-13	1901-0415
CR16	1910-0034
Q1	1854-0009 2N709
U1	1820-0196

5326-8-11

Figure 8-17. Options 010 and 011 and A16 Interconnect Circuit Board

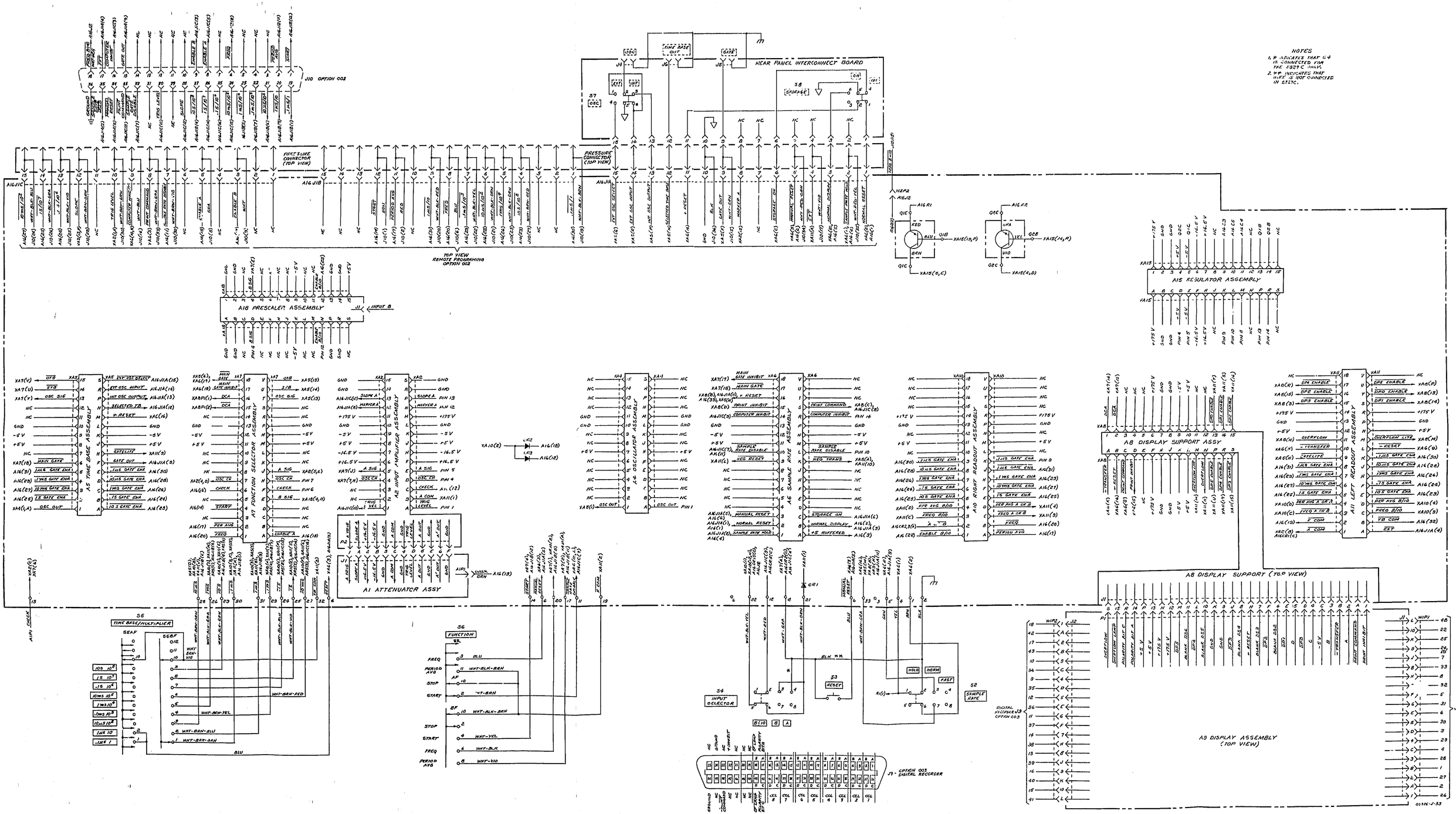


Figure 8-18
5326C/5327C INTERCONNECT DIAGRAM
(Stock No. 05326-90022)

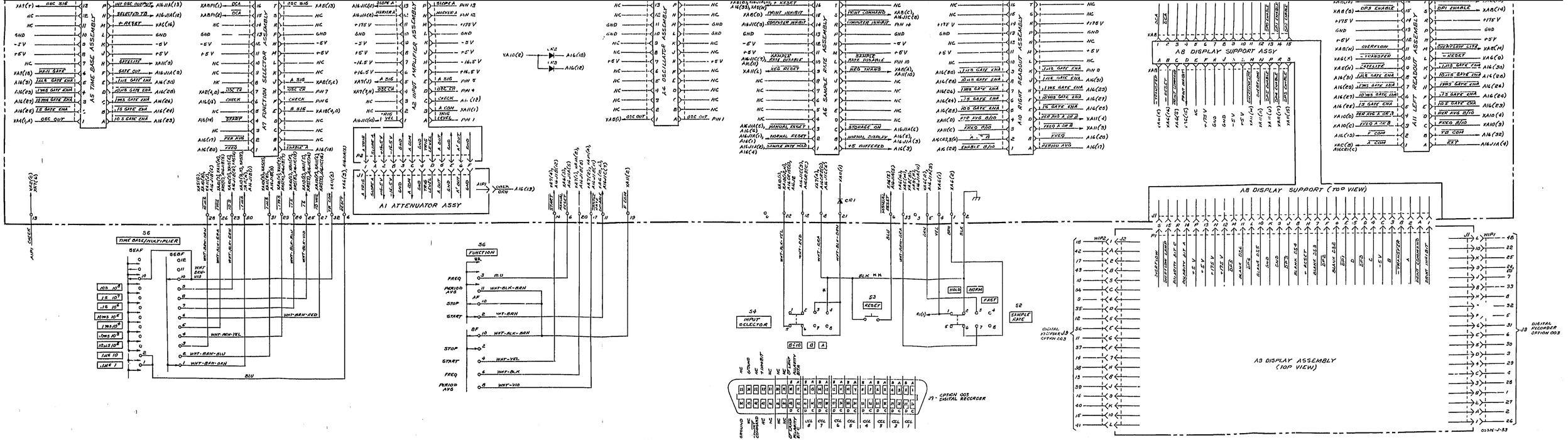


Figure 8-18
5326C/5327C INTERCONNECT DIAGRAM
(Stock No. 05326-90022)

HEWLETT hp PACKARD

MANUAL CHANGES

MANUAL DESCRIPTION

INSTRUMENT: 5326C/5327C Freq. Counters

SERIAL PREFIX: 5326C-1312A
5327C-1312A

DATE PRINTED: JUNE 1974

HP PART NO: 05326-90030

MICROFICHE NO: 05326-90030

CHANGE DATE October 5, 1976

(This change supersedes all earlier dated changes)

- Make all changes listed as ERRATA.
- Check the following table for your instrument's serial prefix or serial number and make listed change(s) to manual.

IF YOUR INSTRUMENT HAS SERIAL PREFIX OR SERIAL NUMBER	MAKE THE FOLLOWING CHANGES TO YOUR MANUAL	IF YOUR INSTRUMENT HAS SERIAL PREFIX OR SERIAL NUMBER	MAKE THE FOLLOWING CHANGES TO YOUR MANUAL
1420A (5326C/27C)	1	1644A (5327C only)	1, 2, 3
1544A (5326C only)	1, 3	1604A (5327C only)	1, 2, 3, 4
		▶ 1620A (5326C/27C)	1, 2, 3, 4, 5

▶ NEW OR REVISED ITEM

ERRATA

Page 6-11, Table 6-1:
Add A15XF1 1400-0110; 1; FUSEHOLDER: 2-PIN; 28480; 1400-0110.
Change "Description" for A16C4 and A16C5 from 700 to 1500 UF.

Page 6-13, Table 6-1:
Change A16U3 from 1826-0085 to 1826-0085 or 1826-0151 in HP and Mfr. Part Number columns.
Add "FACTORY SELECT" after description for A16R34 and A16R42.

Page 6-14, Table 6-1:
Change 1200-0147 to 1200-0081 in "HP Part Number" and "Mfr Part Number" columns and "Qty" to 2.

Page 6-17, Table 6-2:
Add 00779 AMP, INC P.O. BOX 3608, Harrisburg, Pa. 17105.

Page 8-34:
Replace A15 component locator photo with attached Figure 1.

Page 8-37, Figure 8-16, Schematic Diagram:
Add asterisk (*) by A16R34 and A16R42.
In TABLE OF ACTIVE ELEMENTS show 1826-0085 or 1826-0151 for A16U3 and 1820-0736 or 1820-0556 for A16U4.

Page 5-10, Table 5-4, Steps 5c and 5d:
Change 0.65V to 0.9V at A16U2(3).
Change 0.90V to 0.8V at A16U3(3).

Page 8-37, Figure 8-16, A16 schematic:
Change 0.65V at A16U2(3) to 0.9V.
Change 0.90V at A16U3(3) to 0.8V.

Page 6-11, Table 6-1:
Change description for A16C4 and A16C5 from 700 to 1500 µF.

Page 7-21, Paragraph 7-24:
Add following sentence: "An HP Part No. 05326-00033 adapter plate will also be required for mounting 36-pin remote programming connector J10."

ERRATA (Cont'd)

Pages 5-4 and 5-5, 4. PULSE OPERATION:

In step a, set LEVEL (A) to "SLIGHTLY +" in place of PRESET.

Change step c to read "Adjust pulse generator for positive output for 10 MHz repetition rate, 15 ns pulse width for 0.3 volts peak-to-peak indication on oscilloscope."

Change step d to read "Adjust counter LEVEL A control until counter triggers and counts. Check that counter displays the repetition rate, count light flashes, and trigger A lamp is ON. Record on test card."

CHANGE 1 (1420A)

Page 6-11, Table 6-1:
Change A15F1 from 2110-0460 to 2110-0467 1/20 Amp.
Change A15R6 from 0698-1305 to 0698-5470 0.2 OHM; 01121; EB02G5.
Add A15XF1 1251-3205; 2; SOCKET, MINIATURE SINGLE PIN; 00779; 2-331272-7.

With these changes A15 assembly 05327-60020 is "SERIES 1420A REV. D" Component locator in attached Figure 1 is applicable for A15 with SERIES 1312A or 1420A.

Page 6-12, Table 6-1:
Add A16L3; 05303-80001, 1, COIL, FXD, RF PEAKING, 28480, 05303-80001.
Add "FACTORY SELECTED" to A16R34 and A16R42 "Description".

With these changes A16 assembly 05327-60033 is "SERIES 1420A".

Page 6-35, Figure 6-15, A15 schematic diagram:
Change A15F1 value from 1/32A to 1/20A.
Change A15R6 value from 13 to 0.2 OHM.
Change "SERIES 1312A REV. A" at top of A15 schematic to "SERIES 1420A REV. D".

Page 6-37 Figure 6-16, A16 schematic diagram:
Add A16L3 in series with A16U3(13) output line. Output circuit trace is cut and one end of A16L3 is connected to the junction of A16U3(13) and A16R34. The other end of A16L3 is connected to the junction of A6R44 and the coil from A16R42.

Change series number at top of A16 schematic diagram to "SERIES 1420A".

Page 6-12, Table 6-1, A16 Connector Board Assy:
Change A16R7 from 0698-3153 (3830 OHM) to 0698-3155, 4630 ohms. HP and Mfr. Part Number are the same. Change SERIES to 1420.

Page 6-39, [illegible] 6-17, Schematic:
Change A16R7 from 3830 to 4630 ohms.
Change SERIES number at top of schematic from 1224A to 1420A. Make same change on various pages where portions of A16 appear in this manual.

Page 6-13, Table 6-1:
Change A16R29 and A16R30 from 0698-5177 (820 OHM) to 0698-5103, 430 OHM FACTORY SELECT.

Add FACTORY SELECT to A16R30 description.

Page 6-37, Figure 6-16, A16 Schematic:
Add asterisk (*) adjacent to A16R22, A16R23, A16R29, A16R30, and A16R40. All of these resistors should have FACTORY SELECT as part of their description in Table 6-1.

CHANGE 2 (PART OF 1544A FOR 5327C ONLY)

Page 5-10, Table 5-4, Paragraph 4 Prescaler Adjustments:
Change paragraph 5-9 to read as follows: "Reduce output level until counter's display becomes unstable. Alternately adjust A16R3 and A16R53 for a stable display. Repeat procedure until unable to obtain a stable display. Increase signal level until display just becomes stable and make any final adjustments of A16R3 and A16R53."

Page 6-12, Table 6-1, A16 Replaceable Parts:
Change A16 SERIES number to 1540 in "Description" column.

Add A16C30; 0160-3879; CAPACITOR-FXD 0.01 µF 20% 100 VDCW CER; 28480; 0160-3879.

Change A16R22 and A16R23 from 0698-4131 (56 ohms) to 0698-3111; RESISTOR-FXD 30 OHM 5% .125W CC; 01121; BB3005.

CHANGE 2 (PART OF 1544A FOR 5327C ONLY) (Cont'd)

Page 6-12, Table 6-1, A16 Replaceable Parts: (Cont'd)

Change A16R29 and A16R30 from 0698-5103 (430 ohms) to 0698-5177; RESISTOR-FXD 620 OHM 5% .125W CC; 01121; BB6215.

Change A16R34 from 0698-5073 (1600 ohms) to 0698-5178; RESISTOR-FXD 1500 OHMS 5% .125W CC; 01121; BB1525.

Add A16R53; 2100-2633; RESISTOR VAR 1000 OHMS 10% COMP SIDE ADJ; 30P93; EX50X102.

Add A16R54 and A16R55; 0698-3374; RESISTOR-FXD 20 OHM 5% .125W CC; 01121; BB2005.

Add A16R56; 0698-6283; RESISTOR-FXD 10 OHMS 5%; .125W CC; 01121; BB1005.

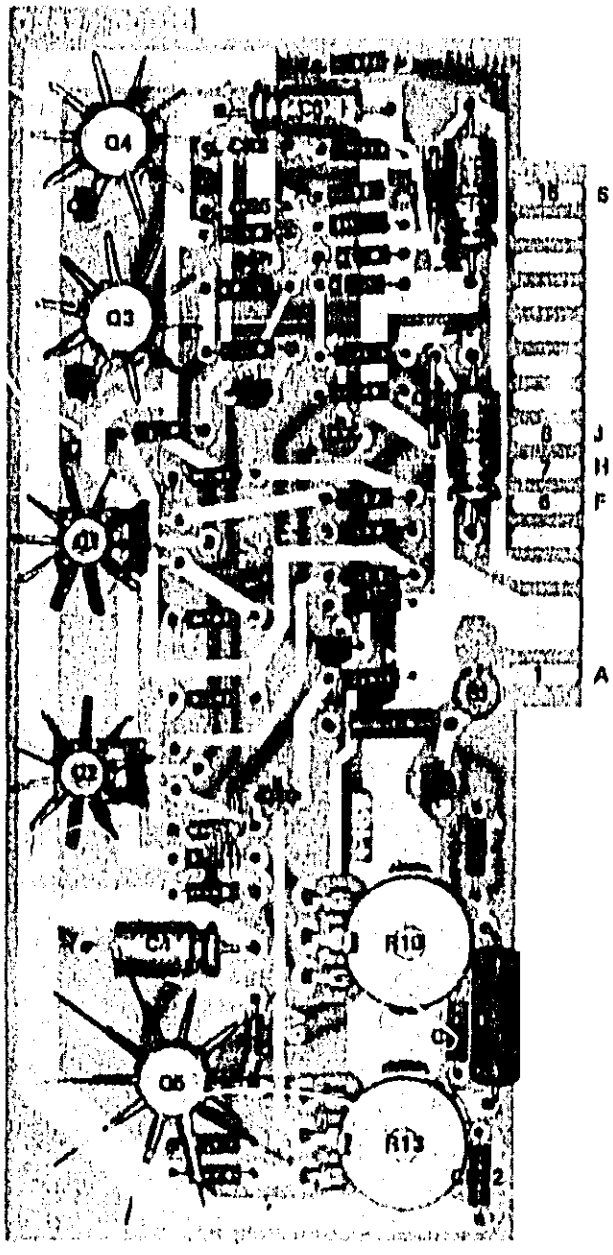


Figure 1. A16 Regulator Board Assembly Component Locator 05327-60020 Series 1312A or 1428A

CHANGE 2 (PART OF 1544A FOR 5327C ONLY) (Cont'd)

Page 8-37, Figure 8-16, A16 Prescaler Assembly Schematic:
Add A16C30 (.01 μF) between common end the "+5V" end of A16R34.

Add A16R53 (1000 ohms) variable resistor between +5.2V and -5.2V. Connect junction of A16C30 and A16R34 to arm of A16R53 in place of "+5V" as shown on schematic diagram.

Change value of A16R34 from 1600 to 1500 ohms.

Change A16R22 and A16R23 from 56 to 30 ohms and remove asterisk (*) adjacent to each resistor.

Change A16R29 and A16R30 from 430 to 820 ohms.

Add A16R54 (20 ohms) in series between A16U2 pin 11 and the junction of A16R23, A16R30, and A16U3 pin 5.

Add A16R55 (20 ohms) in series between A16U2 pin 14 and the junction of A16R22, A16R29, and A16U3 pin 4.

▶ Add asterisk (*) adjacent to A16R54 and A16R55.

Add A16R56 (10 ohms) in series between A16U1 pin 2 and the junction of A16U2 pin 6 and A16R6.

Change "SERIES" number at top of schematic from 1420 to 1540.

CHANGE 3 (1544A FOR 5326C) (PA OF 1544A FOR 5327C)

Page 1-3, Table 1-3, Specifications for OPTIONS:
Add to Option 001: 8-digit display. "Part of standard instrument; discontinued as an Option."

Page 1-4, Table 1-3, Specifications for OPTIONS:
Add to Option 003: Digital Output (for numerals and polarity only). "Discontinued as an Option and included as part of the standard instrument."

Delete Option 010 Temperature Compensated Oscillator. This Option is discontinued and is no longer available.

Page 7-21, Paragraphs 7-9 and above for OPTIONS:
Paragraph 7-11, Add: "Part of Standard Instrument; Discontinued as an Option."

Paragraph 7-22, Add: "Part of Standard Instrument; Discontinued as an Option."

Paragraph 7-17, Add: "Discontinued as an Option and is no longer available."

Page 6-8, Table 6-1, A9 Replaceable Parts:
Replace A9 table for 05326-60008 with table for 05326-60025 A9 on page 6-15 of Table 6-1.

Page 6-16, Table 6-1:
Add parts for Option 003 as part of standard instrument.

The 5326C/5327C Frequency Counters are furnished with the RACK MOUNTING KIT described in this manual. If ordered at the same time as the instrument, the RACK MOUNTING KIT described in the manual is available as Option 908 at additional cost. If not ordered with an instrument, the RACK MOUNTING KIT is available under HP Part No. 05326-60046. Disregard any manual references stating the instrument is supplied with a rack mounting kit.

Page 6-14, Table 6-1, Chassis Replaceable Parts:
Change XF1 fuseholder from 1400-0084 to the following recommended replacement for all instruments. Add the following on Page 6-14 under CHASSIS PARTS:

XF1; 2110-0465; FUSEHOLDER BAYONET CAP; 75915; 345003-020
XF1; 2110-0470; FUSEHOLDER BODY UL/IEC; 75915; 345003-010
XF1; 2950-0054; NUT FUSEHOLDER MTG 1/2-28; 28480; 2950-0054

CHANGE 4 (1604A for 5327C)

Pages 6-12 and 6-13, Table 6-1, A18 (05327-60033) Replaceable Parts:
Change A18 from SERIES 1540 to SERIES 1604.
Add A18R57; 0683-3113; R: FXD COMP 100 OHM 5% 1/8W; 01121; BB1015.

Page 8-37, Figure 8-16, A18 Schematic Diagram:
Change SERIES 1540 at top of schematic to SERIES 1604.
Add 100 ohm resistor R57 in series with +5V input to pin 10 of SCHMITT TRIGGER A18U3.

CHANGE 5 (1620A)

Page 6-6, Table 6-1, A6 (05326-60013), Replacement Parts:
Change A6 series number to 1620.

Change A6C8 from 0160-0153 (.001 μF) to 0160-0299; CAPACITOR, FXD, 1800 PF 10% 200WVDC POLYE; 56289; 202P12292.

Add A6C13; 0180-1736; CAPACITOR-FXD .22 μF 10% 35WVDC TANT; 56289; 150D224 X 9035A2.

Page 6-21, Figure 6-9, A6 (05326-60013) Schematic Diagram:
Change series number, at top of diagram, from "1224A REV C" to "1620."

Change A6C8 from 1000 to 1800 pF.

Add A6C13 capacitor (.22 μF) between circuit board common and junction of A6R12, A6U4B(6), A6CR2 and A6CR3. The positive side of the capacitor goes to the SAMPLE RATE DISABLE line from connector pins 10L and the negative side to circuit board common. Add A6C13 in REFERENCE DESIGNATIONS tables.

HP MANUAL CHANGES

MAKE ALL CORRECTIONS IN YOUR MANUAL ACCORDING TO ERRATA.

Check the following table for your instrument serial prefix and make any indicated changes to the manual:

MANUAL TITLE: 5326C/27C
MANUAL PRINTED: June, 1974
MANUAL PART NO: 05326-90038
CHANGE DATE: 23rd December, 1976.

SERIAL PREFIX	MAKE CHANGE	SERIAL PREFIX	MAKE CHANGE	SERIAL PREFIX	MAKE CHANGE
1443U	1	1644U	1-4		
1443U-00230 (	26C) 1-2				
1443U-00192 (	27C) 1-2				
1619U	1-3				

ERRATA

Page 6-11, Table 6-1
Add : A16XF1 FUSEHOLDER 2 PIN part no. 1400-0110
Change : A16C4 and A16C6 to C FXD 1500uF part no. 0180-2382

Page 6-13, Table 6-1
Change : A18U3 part no. 1826-0086 to "1826-0151 or 1826-0086"
Add : "FACTORY SELECT" after description for A18R34 and A18R42

Page 6-14, Table 6-1
Change : BUSHING TRANSISTOR part no. 1200-0147 to part no. 1200-0081

Page 8-34
Delete : A16 Component Location and insert "Fig 1" new component Location provided

Page 8-37, Fig 8-16, A18 Schematic
Add : "Asterisk" (*) to A18R34 and A18R42
Change : 0.65V at A18U2 (3) to 0.9V
Change : 0.9V at A18U3 (3) to 0.8V
Add : In TABLE OF ACTIVE ELEMENTS show 1826-0086 or 1826-0151 for A18U3 and 1820-0736 or 1820-0558 for A18U4.

Page 7-21, Paragraph 7-24
Add : following sentence: "An HP Part No. 05326-00033 adapter plate will also be required for mounting 36-pin remote programming connector J10".

CHANGE 1
Table 6-1, Page 6-11
Change : A16R6 to part no. 0698-5479 R FXD 8.2Ω 5%
A16F1 to part no. 2110-0487 1/20 Amp.
Add : A16XF1 1251-3205 Socket : Miniature
With these changes assy 05327-60020 is Series 1443U REV D
This change supersedes applicable data in Errata.

Page 8-35, Figure 8-15, A16 Schematic
Change : A16F1 value from 1/32A to 1/20A

CHANGE 2
Table 6-1
Change : Rear Panel part no. 05326-00032 to part no. 05326-60049

CHANGE 3
Page 6-13, Table 6-1
Change : A18R29, 30 to part no. 0698-5103 R FXD 430Ω 5% ⅛W
Add : Asterisk (*) to A18R22, 23, 29, 30, 40 to indicate select on test.

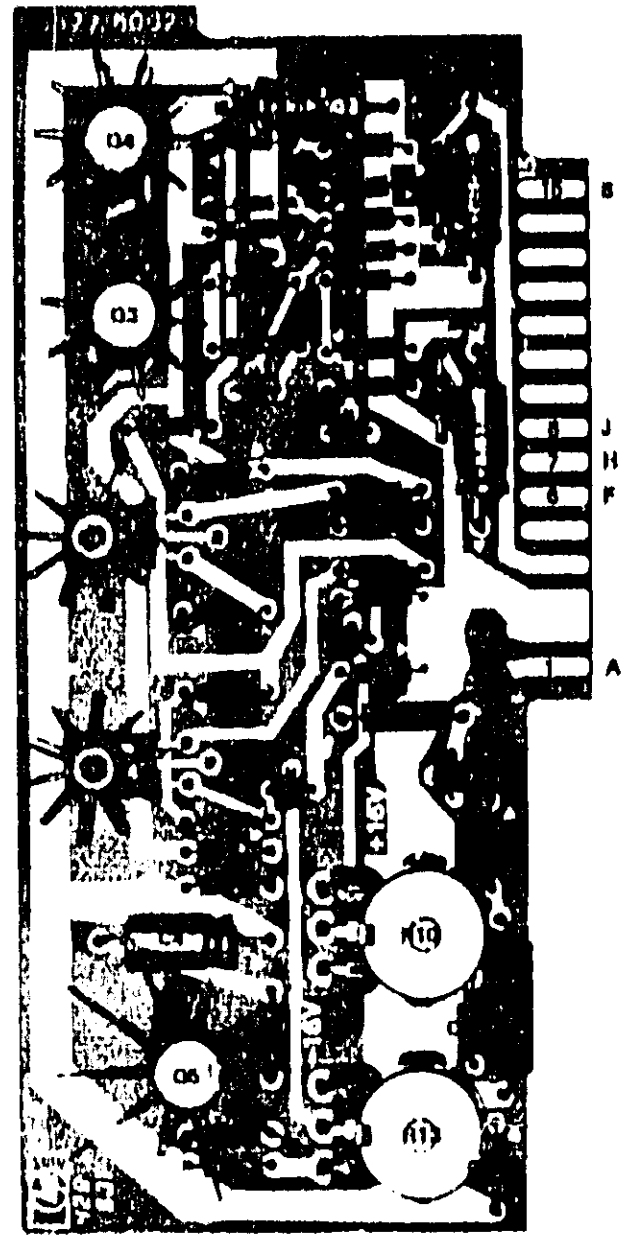


Fig. 1 A16 Component Location.

CHANGE 4

Page 1-3, Table 1-3 Specifications for OPTIONS:
Add : to Option 001: 8-digit display. "Part of standard instrument; discontinued as an Option".

Page 1-4, Table 1-3, Specifications for OPTIONS:
Add : to Option 003: Digital Output (for numerals and polarity only). "Discontinued as an Option and included as part of the standard instrument"
Delete : Option 010 Temperature Compensated Oscillator. This Option is discontinued and is no longer available.

Page 7-21, Paragraphs 7-9 and above for OPTIONS:
Paragraph 7-11 Add: "Part of Standard instrument; Discontinued as an Option"
Paragraph 7-22 Add: "Part of Standard instrument; Discontinued as an Option"
Paragraph 7-17 Add: "Discontinued as an Option and is no longer available"

Page 6-8, Table 6-1, A9 Replaceable Parts:
Replace A9 table for 05326-60008 with table for 05326-60025 A9 on page 6-16 of Table 6-1

Page 6-16, Table 6-1:
Add : parts for Option 003 as part of standard instrument.